NATIONAL CONFERENCE ON TECHNOLOGY AND INNOVATION

JANUARY 13-15, 1988

TORONTO, ONTARIO

PROCEEDINGS

Canada

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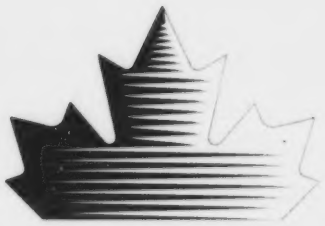

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CONFERENCE SECRETARIAT
National Conference on
Technology and Innovation
240 Sparks St.
Ottawa, Ontario
K1A 1A1
(800) 267-3363
(613) 998-4594

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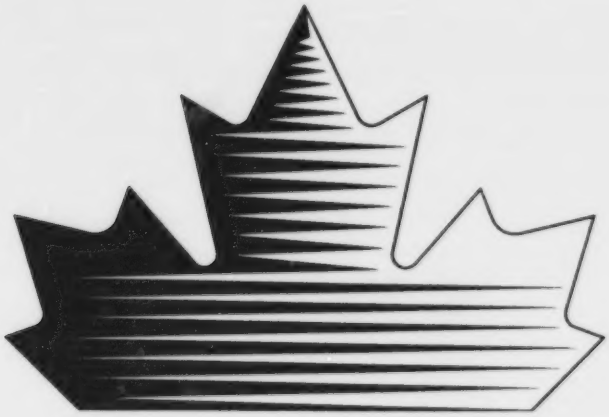
INNOVACTION
The Canadian Strategy for Science and Technology
La stratégie canadienne en matière de sciences et de technologie



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Canada

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Cat. No. ST51-1/1988E rev.
ISBN 0-662-16249-8

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"[Increasing spending on research and development] is not just the federal government writing a cheque for borrowed money; it is creating the climate within which the private sector, especially, responds to a great national challenge."

The Prime Minister of Canada
the Right Honourable Brian Mulroney

"The new Department of Industry, Science and Technology will have the mandate to work towards a closer integration of Canadian industry with Canadian scientific knowledge and technological skills."

The Honourable Robert R. de Cotret
Minister of Regional Industrial Expansion and
Minister of State for Science and Technology

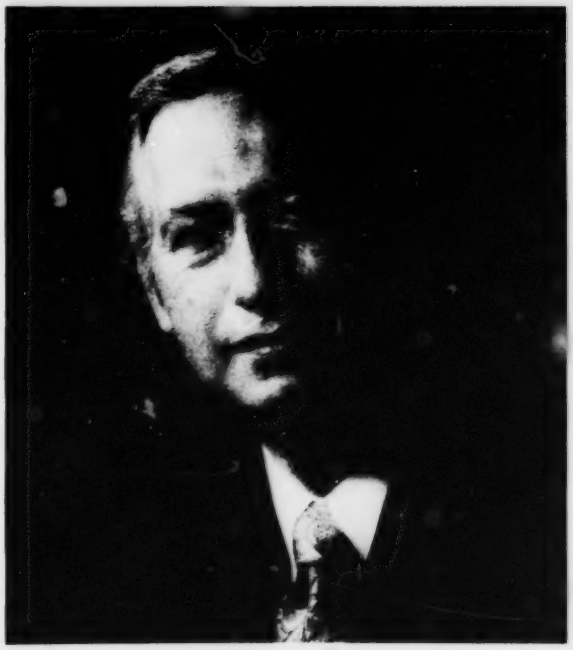
"Science and technology must become part of every Canadian's daily experience."

The Honourable Frank Oberle
Minister of State (Science and Technology)

ROBERT RICHARDSON

EXECUTIVE DIRECTOR
NATIONAL CONFERENCE ON
TECHNOLOGY AND INNOVATION

Dr. Robert Richardson is a private consultant and Director of several major companies. He has served as President of Bell Canada Enterprises, Inc., as Executive Vice-President of E.I. Du Pont de Nemours Co., and as Chairman, President and Chief Executive Officer of Du Pont Canada Inc.



INTRODUCTION TO PROCEEDINGS

Canadians have benefited from a high level of economic prosperity for much of the post-war era. Our wealth of resources and our ability to compete in international markets have helped sustain a healthy level of economic growth.

However, the world is changing. The emergence of new international competitors and changed global markets have meant that Canada cannot be complacent about its competitive position. Trade in goods with high value-added, particularly those goods with a high content of technology, has become very important. Trade in resource products, while still important, has become highly competitive as new, lower-cost producers have begun to compete in export markets. In the resource sector, as with manufactured goods, companies and countries are using technology to provide a competitive edge. This is the challenge faced by Canadian industry.

This challenge was the principal reason for having the National Conference on Technology and Innovation. It was also the reason why conference participants were chosen from amongst the highest-level decision-makers in large and small Canadian companies, universities, government agencies and labour unions. Leadership is the key to effecting the changes that will be necessary to enhance Canada's competitive position.

The conference was convened by the Prime Minister and co-chaired by the Honourable Frank Oberle and the Honourable Robert de Cotret, the two federal Ministers with responsibilities in the areas of science, technology and industrial policy. In their remarks, the Prime Minister and the two Ministers emphasized the government's commitment to science and technology. The Prime Minister challenged the participants to help make Canada more competitive in the international marketplace through the use of technology.

The conference heard from leaders in Canada's corporate world about the importance of science and technology and what Canada, particularly the private sector, must do to develop and use technology and become more innovative. Most important perhaps, the conference provided an opportunity for participants to have a meaningful dialogue in workshop sessions where they could discuss the issues in depth.

A strong consensus emerged from the conference that Canadian culture is itself a significant barrier to becoming a more technologically oriented and innovative country. It was noted many times, for example, that more of our key decision-makers, whether in the corporate boardroom or in Cabinet, should be people with at least some training in science or engineering. These proceedings are a record of how this consensus emerged

and a record of the thoughts of leading Canadians on what we — companies (both management and labour), universities, governments — must do together in terms of developing and applying technology.

This document is the official record of this special gathering. Included here are the keynote addresses, including those of the Prime Minister and Ministers Oberle and de Cotret, and the summary reports of the workshop discussions. For those who attended this conference, as well as for those who did not, this will be a useful record of what went on at this historic meeting.

THE PRIME MINISTER OF CANADA
THE RIGHT HONOURABLE

BRIAN MULRONEY

OPENING ADDRESS

JANUARY 13, 1988

[English]

I want to welcome you all to Toronto and to this National Conference on Technology and Innovation.

I have asked you here for a very simple reason — we need your help. We need you to help Canada create a consensus on technology and innovation, to help us find ways of achieving comparative advantages, to help us define new goals for attaining competitive excellence through research and development.

It is my genuine hope that this conference, with its themes of challenge, change and celebration, will be seen as having made a lasting contribution to the promotion and development of science, technology and innovation throughout Canadian society.

[Translation]

With this conference, we begin a new stage in consultation and cooperation among government, business, labour and the academic community.

With this conference, all Canadians will have an opportunity to reflect on our international competitive position and the imperative of improving it. All Canadians must share a commitment to make our economy more competitive in the quickly changing international marketplace.

For a trading nation such as ours, it is essential to maintain and improve our competitive position.

[English]

How could it be otherwise? Foreign trade accounts for 30 per cent of everything we produce, twice the level of Japan and more than three times the level of the United States. Just think of that for a second. Quite simply, trade abroad means jobs at home. This is critical to ensure the prosperity that is key to achieving the goals Canadians cherish — fairness and compassion, a clean environment and equality of opportunity in all our regions.

Our government has worked consistently to restore Canada's competitive position in the world and to invest in areas that will secure our ability to compete in the future.

[Translation]

That is what national reconciliation and economic renewal are all about. National reconciliation means pulling together to achieve a common purpose — not pulling apart. The Meech Lake Accord marks a new beginning. But it is as well a reflection of a deeper spirit of understanding, cooperation and respect that characterizes our government's approach to federal-provincial relations.

"Canadians are aware that our future prosperity largely depends on our ability, as a nation, to use science and technology to our advantage."

This spirit has contributed to an agreement to create a National Council of Science and Technology Ministers to oversee the implementation of a national policy on science and technology.

[English]

Economic renewal means establishing government as a partner in economic growth — not as an obstacle to it. To stimulate economic renewal, we have kept tight control on the deficit and managed our expenditures carefully. We have reduced and streamlined unproductive regulation in energy, transportation and other areas.

We have adopted, through the Atlantic Canada Opportunities Agency and Western Diversification Office, a new and innovative approach to government via regional development — by putting money and authority in the regions, close to people who know where the opportunities are.

We have reformed the tax system to make it fairer and more effective.

We have negotiated a major trade agreement to secure and improve our access to the United States of America. We are in the vanguard of efforts to liberalize trade on a global basis through the Multilateral Trade Negotiations, where trade in services and agriculture are on the agenda for the first time in the history of the GATT. Imagine what the combination of these two punches can mean to the regional economies of Canada; to the capacity, for example, for western Canada to trade into magnificent new prosperity; for Quebec and Ontario and the Atlantic region to achieve unequalled *degrees of productivity enhancement*, a greater degree of competitiveness, the attraction of new investment and the creation of new jobs.

The results have been good for Canada.

Over the last three years, Canada has achieved the strongest economic growth in the Economic Summit group, the seven leading industrialized democracies which will meet here in Toronto, at my invitation, in June. I wanted them to see a world-class city — one of the finest in the world. I wanted them to be here to see what the cooperation between government at all levels and between the agencies of government and the private sector has meant to Ontario and to Canada.

We have also brought about renewed confidence in Canada, leading to greater investment, lower interest rates.

There has been a remarkable drop in our unemployment rate that has exceeded the expectations of, I think, all economic forecasters, from 11.7 per cent when the government took office to 8.1 per cent today, a decline of nearly one-third. Just consider that for a second. Youth unemployment, which was one of the biggest problems when we assumed office, is down by five percentage points. Unemployment has dropped dramatically with the creation of more than 1.1 million new jobs since I was sworn in as Prime Minister in September 1984. Some 85 per cent of these jobs are full-time, reversing a trend that was going in the opposite direction. Fully 55 per cent of those jobs have gone to women.

These are the objectives that the National Advisory Board on Science and Technology has spelled out as well, because you have not been dealing with science and technology in the abstract. You have been dealing with it, as well, in terms of job creation and the fairness of the distribution of those jobs.

I suppose that statistics of unemployment really don't tell the story; it's the quality of the jobs, and it's what you have achieved. If the statistics mean something to you here, what do you think they mean to somebody who didn't have a job? What do you think that a million jobs means to somebody who now has a job?

In fact, the 474,000 jobs created in Canada last year constitute the largest job increase in any calendar year since data has been collected by Statistics Canada.

I thank you all for your appearance here today, and I thank you all for your tremendous contribution over the last while.

Our challenge, yours and mine, is to maintain this performance, not in the abstract. Our challenge is to maintain those numbers and do better. To do so, we must continue to act now to ensure we remain competitive in the future. It's the only reason that people will buy our products. They won't do it, as I said before, because of the cut of our jib or the colour of our eyes. It will be because of our capacity to deliver high-quality products at prices that are competitive internationally. Provided that we have access to the markets, I think that if we put in that mix of technology and commitment such as that we have seen here, this can develop into one of the most tremendous opportunities that any of us have ever seen. That is why science, technology and innovation have been priorities of the government since I have had the honour of being Prime Minister.

Canadians are aware that our future prosperity largely depends on our ability, as a nation, to use science and technology to our advantage. They know that we must maximize the strengths of our resource-based economy and that, as a national priority, we must develop new industries, produce new goods and offer new services. The way to do that — and there are not half a dozen different ways — is through a concerted national effort in science and technology.

I have often quoted Walter Light in respect of something he wrote: "Technology is like oil. You cannot do without it. If you do not have it, you must buy it from those who possess it. And like oil, you must buy it at their price. However, contrary to oil, you can create technology. It is one of the rare resources which is inexhaustible."

I think Walter Light was right. We must work together — on behalf of the future well-being of all Canadians — to develop and implement a national approach to science and technology that will prepare Canada for the next century. We should, at this conference, take stock of where we are coming from, where we are and where we want to go.

We are making some progress in building a better science and technology framework. Since we came to office, we've looked on science and technology as a national priority, and we have done a few things about it.

First, we established the National Advisory Board on Science and Technology (NABST). It brings together some 40 eminent Canadians from all walks of life, whose only motive is to enhance Canada's standing in the scientific world.

In only nine months since its formation, there have been over 50 meetings of NABST committees, which have been doing excellent work.

I took on the responsibility, as Prime Minister, of chairing the National Advisory Board on Science and Technology, and I have met for countless hours, as chairman of that board, in private, without the television lights there, on four or five occasions over the last eight or nine months. I do that not because I have nothing else to do, but because, in my order of priorities, the development of a cohesive and coherent science and technology policy is demonstrably at the top of our national requirements.

"While we have some reasons to be optimistic, we have no reason at all to be complacent."

As chairman of NABST, I count on its members not only for the quality of their analysis and advice, but also for their guidance in implementing new ideas and programs.

Second, we have developed the InnovAction program. It will focus science and technology efforts in five critical areas:

- industrial innovation and technology diffusion;
- development of strategic technologies;

- effective management of federal science and technology resources;
- human resources for science and technology; and
- public education in science and technology.

Third, we are setting up a new Department of Industry, Science and Technology — doing that essential marriage between government, universities and the diffusion of new technologies. This department's mandate will reflect the government's commitment to a competitive and technologically advanced industrial economy that will foster Canada's long-term international competitiveness.

Fourth, we have ensured that R&D will continue to receive special tax treatment under tax reform. Both current and capital expenditures qualify for an immediate write-off and a 20 per cent credit. Rates of credit are higher for small private firms performing R&D.

It's not perfect, but it is generally acknowledged that Canada's R&D tax incentives are among the most advantageous offered internationally and compare favourably with our major competitors, in particular the United States of America.

[Translation]

Fifth, we have created a Standing Committee of the House of Commons on Research, Science and Technology to provide, for the first time, a continuing parliamentary focus on this vital area of national public policy.

Sixth, as those of you from Ontario and Quebec will remember, we have enacted new patent legislation, Bill C-22, which will encourage research, protect intellectual property and which, in the pharmaceutical sector alone, will attract $1.3 billion of new investment and create 1,300 new quality jobs here in Canada.

Seventh, as I indicated earlier, we have agreed on elements of the National Science and Technology Policy with the provinces and territories, and we have set up a National Council of Science and Technology Ministers to oversee its implementation.

[English]

We have also seen some progress at the industrial level. In terms of overall international competitiveness, the World Management Forum in 1987 ranked Canada sixth among the 22 OECD countries. Three years ago, Canada was eleventh. Canada's industrial R&D spending has increased dramatically, by two-thirds since 1981. In telecommunications, Canadian firms spend $2.50 on R&D for every dollar spent by their American counterparts. In aerospace, the ratio is $3.70 for every dollar spent by our competitors.

While we have some reasons to be optimistic, we have no reason at all to be complacent. In many areas, we aren't performing as well as our major competitors. Nor are we achieving our own potential for excellence.

Even though industrial R&D is increasing, it is highly concentrated in relatively few industrial sectors and companies. The top four R&D companies account for almost 30 per cent of total industrial spending on R&D.

Though we are second only to the U.S. in the number of college graduates as a percentage of the work force, we have one of the lowest rates of scientists and researchers in the population — only 90 per 100,000 population, as compared with 140 in Britain, 150 in West Germany, 240 in Japan and 280 in the United States. This is not something that happened overnight. It's a matter of decades of neglect before that kind of statistic starts to kick in.

Private-sector support to education accounts for only 1 per cent of university revenue in Canada as compared with 7 per cent in the U.S. And the private sector provides only 3 per cent of the funding for R&D in universities.

Canada spends three-tenths of one percent of its GDP on university research, slightly less than France and the U.S., significantly less than Japan and only half as much as Sweden.

"I want very much to stress the critical importance we attach to education, as the foundation on which durable science and technology policies must be built."

Canada has a much lower level of international patenting than other major countries, and 93 per cent of patents developed and held in this country are held by non-Canadians. This didn't happen overnight either. This is a reflection of the lackadaisical attitude that we have adopted in respect of science and technology over decades.

We have failed to recognize the importance and magnificence of the discipline and failed to motivate and reward those who give their lives to a proposition that can only make Canada a better country.

West Germany and Sweden lead the way with more than five times as many patents per 100,000 residents. Canada lags behind, with only half as many as the U.K.

Canada had a trade deficit of $7 billion in all high-technology product groups for 1986. This included a deficit of $2.4 billion in computers and related equipment. Aerospace was the only high-tech sector with a positive trade balance.

There's a message for all of us in there. We've done some good things, we're making significant improvements, but the challenge is clearly defined for all of us to see. We have some weak spots that we can only deal with together.

[Translation]

We have to continue to face several challenges.

These issues and others you will identify will serve to define a national agenda for action, an agenda for government and the academic community, for business and labour alike. It is an agenda that will help us to foster a culture of science and technology, so that all Canadians will recognize that science and technology are keys to securing our prosperity and our quality of life.

I would like to leave you with my thoughts on some of the leading issues.

[English]

I believe that realism must prevail in any discussion of increasing federal government spending dramatically in the very short term. It is counter-productive to spend borrowed government money in a manner that will cause interest rates to rise, thereby severely limiting the capacity of the private sector to participate in national endeavours in this area.

It may seem appealing to some to simply commit more borrowed funds to the task, but I think Canadians have learned that you cannot spend what you have not earned. We must and we will devote more government funds to science and technology but in a sensible and productive way.

Let me put it in perspective. Federal funding of science and technology in 1987 amounted to $4.1 billion. In the province of Ontario, for example, the federal government spends ten times as much as the Government of Ontario on research and development.

In examining federal funding, we welcome your advice on how to spend smarter. For some years, I have been speaking and writing about the need not only to increase the amount we spend, but also to re-examine the way we spend and the incentives that guide decisions.

Take a look at this. We abolished the Scientific Research Tax Credit that had been introduced in 1983, which in one year, had allowed the diversion of hundreds of millions of dollars of badly needed research funds away from research and development and into quick flips and paper profits. The research and development community was brutally assaulted by an ill-conceived tax incentive that ultimately was very damaging to the research and development community in Canada. We had to begin by abolishing what was clearly a boondoggle that worked to the detriment of those who believe in research and development and those who commit not only their lives but also the well-being of their institutions to genuine R&D. We had to cut off at the knees this instrument that was being used to move paper and flip profits. Consider the amounts, which were extraordinary in regard to our total capacity for research and development in Canada.

[Translation]

There are further areas where we welcome your advice on how to spend smarter: procurement, contracting out, basic research versus product development and departmental expenditures versus granting councils. Nor can science policy be considered in isolation from our national objectives in tax reform, trade, defence and other elements of the government agenda.

It is thus important to recall the linkages between science and technology and other economic and social policies.

Consider the linkages between science and technology, trade, and labour market adjustment. Let me quote Dr. John Polanyi, Canadian Nobel laureate and a member of NABST. As Dr. Polanyi has said, as quoted by Maclean's magazine last October: "Free trade is the way of the future. In science, there is no duty levelled on ideas, and we compete internationally. It is a logical extension that business, which depends on ideas, competes internationally."

Trade liberalization will increase opportunities to develop new knowledge-based products by providing more secure access to the richest market in the world. And effective science and technology policies can help to ensure that those

opportunities are realized. As they are, faster growth and higher incomes in Canada will ease the process of labour market adjustment to the new opportunities that free trade offers.

I want very much to stress the critical importance we attach to education, as the foundation on which durable science and technology policies must be built.

[English]

We should, as a people, as a nation, recognize the importance of ensuring that our children are prepared to meet the challenges of the 21st century. This requires a world-class educational system, whose corner-stone is the teachers — the best teachers that a civilized, highly developed nation can produce, motivate and reward. To teach is to shape and to guide and to lead. Surely those to whom we entrust such sensitive and important tasks must, in becoming the best, be celebrated as such by all Canadians.

Even in a period of restraint, we have enhanced federal support for higher education, now at $6 billion a year in direct and indirect transfers. Our support has increased at a rate of 5 per cent a year, faster than the rate of economic growth and faster than the rate of inflation. I tell you that more is required to assist our teachers to achieve the heights which they are capable of and the rewards to which they are entitled.

If our national goals are to increase Canada's competitiveness and role in the world, clearly our educational goals must prepare us to meet that challenge. Sadly, many Canadians face the hardship and constriction of illiteracy. It's hard to believe, in a country like ours, that illiteracy is a problem, but it's a big one. And it's a special one for those who reach a mature age and could be productive members of the work force and, for whatever reason, do not have the skills of reading and writing. Without those skills, their productivity and their contribution to our national well-being is fundamentally very limited.

We've begun to deal, as a nation, in a substantial way, with this human tragedy. Forget the industrial problem and the addition to our economic well-being. Imagine the human tragedy of somebody who's 45 or 46 years of age, who has four kids, who is confronted with the reality of admitting to his children that he can neither read nor write. Illiteracy is becoming one of the serious problems of civilized societies, and we must begin in earnest and in a substantial and thoughtful way the process of dealing with it. We began in Saskatoon, at David Crombie's National Forum on Post-Secondary Education.

We established the National Literacy Secretariat in the department of the Secretary of State. With the collaboration of the provinces and the help of the non-governmental sector, we have begun the battle to end illiteracy in Canada. We cannot afford to limit the mind of a single Canadian. You know that all the policies and programs in the world will get us nowhere if our people are not properly trained to carry them out.

I believe we have a good record of achievement in science and technology and, most of all, a record we can build on. We have not made all the progress hoped for. But we have put in place all the vital building blocks that will ensure solid and unrelenting progress for Canada in this important area.

I am announcing today additional federal funding of $1.3 billion for new federal science and technology initiatives over the next five years, funding that recognizes the regional realities of Canada.

This funding will be allocated among a number of new programs and initiatives such as a national program of Centres of Excellence on university campuses. The broad purpose of the program is to establish networks of researchers and scientists across the country to conduct world-class research in areas crucial to Canada's long-term competitiveness. An independent jury of internationally recognized experts will be formed to advise the government on proposals submitted. The identification of the centres, their number and the level of funding will be based on the recommendations of the jury.

"We can meet the challenge of technology and innovation only if we strike a resolve to meet it together."

We are also going to create the new Canada Scholarships in science and engineering and related disciplines for an estimated 2,500 worthy university students across the country every year. When the program comes to maturity at the end of a four-year phasing-in process, 10,000 Canadian students on an ongoing basis will benefit from a generous and effective scholarship program designed to attract the best into science and engineering. The proportion of undergraduates in these fields has remained static since 1970, and this program will begin to change that and provide gifted students across the

country with a unique opportunity to excel in areas vital to our national well-being.

I have asked Ministers de Cotret, Oberle and Crombie to discuss implementation of these and other initiatives with the provinces and territories, as well as the private sector.

We must, as a country, become known not only for the wealth of our natural resources but also for the richness of our intellectual potential. That is the true challenge before this conference. That is the true challenge before this country.

Canadians generally do not shrink from such challenges — we tend to welcome them.

Canadians know that this country was not built by the faint of heart. It is the pioneering spirit of Canadians that rolled back a wilderness, met the immense challenges of the north and built world markets for our products. It is the spirit of a people known for their daring and for their commitment to education as the means of achieving enlightenment and excellence. As a consequence, we have built in this country a society whose chief value, whose chief quality, is tolerance — religious, linguistic, ethnic. This is the greatest contribution that we can make to a civilized society. That's what it's all about. At the end of the day, when the measure is taken of all of us, it will be said, did he or she contribute in every way to the evolution and the building of a Canada that was more tolerant.

Prosperity, we have achieved. Growth, we're at the head of the class. Trade, we're building new patterns around the world with daring and effective leadership. But the ultimate question is tolerance. And I think that in the process of federal-provincial relations, of working together, that we are building the kind of society which I cherish and which, in my judgement, is the key to judging the kind of soul that Canada truly has.

There's a role for every one of us in this. No one has any proprietary rights. If it were easy, it would have been done a long time ago. If perfection were easily achieved, then of course it would simply require a Prime Minister sitting in 24 Sussex to design the kind of country that he wanted, and that would be the end of it. But you've got to get out and fight for it. You have to fight intolerance. You have to fight for the kind of Canada that you believe in, that we all believe in, that you're all contributing to here today. Another important essential of our country is that it has to be competitive. It has to be attractive, it has to be dynamic, and it has to be a world leader. Think about our kids. I received some letters the other day from some children in Barrie, Ontario. These were children of seven years of age in grade two. Because of the nature of their letters, I was reminded of the fact that when they're hitting the marketplace, it will indeed be the 21st century. At this conference, we are being asked to define what kind of country we will have for those who will inherit it.

We can meet the challenge of technology and innovation only if we strike a resolve to meet it together. We must, as a nation, summon the will and allocate the resources so that this country can achieve its splendid promise, so that our children can realize the dreams that our own parents held for us and for our country.

It is mindless for government to blame industry, for industry to blame government or for both to reproach the universities for Canada's failure to achieve its complete potential in technology and innovation.

The fact is that nobody's going to help us. We're all Canadians. We're all in this together, and we have to do it together in an increasingly competitive world. The government has been challenged to do more by you, through the various panels, through your organizations and through the leadership of various councils. We accept that challenge, and we welcome it. In turn, I ask what are you going to do?

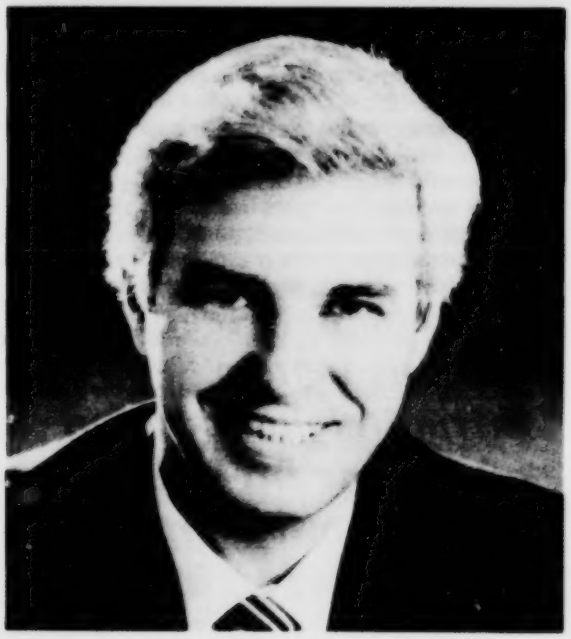
This is a pretty impressive group of people. This is a truly impressive gathering of people committed to research and development and science and technology. If you have questions for me, and you have, I have questions for you. This group represents the leadership of those who genuinely understand and believe in a competitive Canada and our role in the 21st century. My principal question to you is: What are you going to do to help establish the new industrial, technological and educational environment and infrastructures required to help Canada become the world leader we want it to be and that it must become?

I thank you for being here, and I count on you for several things. First, for your straight talk. I count on you for exciting ideas. I count on you for unvarnished opinions. We are in it together.

In inviting you here, we've brought together the best that Canada has to offer, and I thank you for your presence, I thank you for your commitment, and I look forward to receiving your recommendations on Friday morning and discussing them with you then.

PIERRE LORTIE

CHAIRMAN & CHIEF EXECUTIVE OFFICER
PROVIGO INC.



Mr. Lortie, an engineer and economist, is President of the Federal Advisory Group on International Trade for the Consumer Products Sector and Chairman of the University Committee of the National Advisory Board on Science and Technology. He is a member of the Prime Minister's Advisory Committee for the Management Exchange program between business and the federal government, and an administrator and member of the Executive Committee of the Canadian Chamber of Commerce. He is also a member of the C.D. Howe Institute and the Canada-United States Committee. He is a Director of the Retail Council of Canada, the Canadian Institute for Advanced Research and of Tecrad Inc. Mr. Lortie is also Chairman of the Board of Governors of la Fondation du sport universitaire québécois. He is a Director and member of the Executive Committee of Consumers Distributing and of the National Bank of Canada. He is also a member of the Board of Directors of Unigesco and Sobeys Stores Ltd.

SHAPING CANADIAN SOCIETY TO COMPETE AS A KNOWLEDGE-BASED ECONOMY

KEYNOTE ADDRESS

JANUARY 13, 1988

I am greatly honoured to have the opportunity to address this National Conference on Technology and Innovation. In many ways, this conference is about the future, about how, as Canadians, we will harness our resources to ensure that we remain at the forefront of advanced nations. Thus, and notwithstanding its title, this conference should not be about esoteric scientific or technological matters; it will purport directly to values, choices that we must make as a people. It should come as no surprise, then, that our debates, and those that will undoubtedly follow recommended policy direction, will also mirror our society's most important value conflicts.

The main message I want to leave with you is that the nature of our science and technology challenge is one that embraces the whole fabric of our society. It would be a sad and costly error to focus our discussions and the policy actions that might ensue solely on R&D or high-tech firms. Admittedly, these are important elements of knowledge-based societies. But we must never lose sight of the fact that these blossom best if the whole environment is intellectually nourishing and conducive to their growth. I submit that the environment in Canada is seriously wanting in this regard. Therefore, what is urgently required is not simply a few more dollars to support some scientific projects, but a whole new set of attitudes acknowledging the crucial importance of science and technology as key factors in sustaining a high quality of life. These new attitudes are needed from a large majority of, if not all, Canadians.

To achieve such a widespread social consensus, it is essential that we reach an agreement regarding the nature of the challenges facing the Canadian

economy. It is easy to be complacent about the current situation. The Canadian economy is currently performing well. In terms of economic growth, Canada has had one of the best records among all major industrial countries over the past five years, even though unemployment remains at a comparatively high level. Moreover, according to most forecasts, the Canadian economy is expected to continue to perform relatively well during the next few years.

"The competitiveness of nations is now intimately associated with their investments and commitments to science and technology."

This happy state of affairs must not become a reason for inaction; it must be used as a breeding ground for effecting a much needed transformation of our productive apparatus.

Tomorrow's competition will be markedly different from what we have experienced in the past. Growing international competition and a more continental economy, accelerated by the conclusion of the Free Trade Agreement with the United States, are changing the rules.

Progress in technology, transportation and communications has created a global economy. Many of our business people, in fact the majority, have no experience in dealing in this global market. As a result, we are becoming increasingly dependent on imported technology. Generally speaking, our international competitors are tougher, more aggressive and understand better what it takes to succeed in the new environment. More than anything else, technology or, more precisely, the ability to transform technological advances into a competitive tool, will determine the winners and losers. Canada has not risen to the challenge of technology as well as other industrialized countries. The few successes we have had are the exceptions which confirm the rule. The bottom line is that Canada has yet to learn to harness the full potential of technology.

Historically, our rich endowment of natural resources has allowed us to sustain a high standard of living. Natural resources will undoubtedly remain important in the future and, in certain regions, they will continue as the backbone of the economy. However, the fact remains that the terms of trade have deteriorated against commodities, primary materials and semi-finished materials, and we must expect this trend to continue over the next twenty years.

Because natural resources loom so large in the Canadian psyche, we have tended to neglect modern theories of economic growth. Empirical results of the contribution of science and technology to GNP and productivity growth in the western world should remain at the forefront of our thinking. During the 1929 to 1967 period, factor inputs of capital and labour accounted for only 45 per cent of productivity growth, whereas advances in science, technology and organizations contributed 55 per cent.

Thus, scientific knowledge, organizational innovation, product innovation and technological innovation constitute new factors of production that can be harnessed by countries, entrepreneurs and managers. The traditional view that international trade is based on natural comparative advantages is incomplete; international trade based on created competitive advantages is becoming the norm in an increasing number of industries. The competitiveness of nations is now intimately associated with their investments and commitments to science and technology. And this is a rendezvous that Canadians have been postponing for too long now.

Canada's total expenditures on R&D as a percentage of GNP have varied between 1 per cent and 1.3 per cent over the last two decades. Its current level, which stands at 1.3 per cent of GNP, is low compared to other industrial nations. For example, Japan, the United States and West Germany spend approximately 2.5 per cent of GNP on R&D. Although one needs to be careful with such figures, it seems clear that Canada is a low spender. And given the relative size of these economies, the differences in absolute dollars of spending are staggering.

This low investment in R&D is not solely due to the nature of our economy and its heavy dependence on branch plants. Even in areas where we control decisions, such as funding of university research, Canada is performing poorly. In fact, funding for university research, especially by the federal government, declined dramatically in the seventies and has not recovered since then.

Canada is slow to adopt innovations. The diffusion of technology in Canada is lagging on several counts. We often adopt new technology later than in the leading industries of other nations. Moreover, within Canada, there are significant regional time lags which further compound the problem. Finally, the inadequate training given to managers and workers often leads to resistance to adopting new technologies or

to adopting new technologies without properly exploiting their potential. In its most recent study on innovation, the Economic Council of Canada concluded that "Canada's persistent lag in the introduction and use of computer-based technologies is an urgent national problem of major proportions."

Canadians do not demonstrate a faith in scientific progress, as evidenced by our unusually low proportion of indigenous applications for patents: in 1983, Canadians filed slightly more than 2,000 patents, which represents only 8 per cent of total applications in Canada. Further analysis reveals that Canadians' rate of invention is lower than in other countries and that we are not as active in newer technologies.

Few large Canadian firms have acquired the capacity to use technology for entry into worldwide markets or to penetrate new industrial sectors. Northern Telecom and Bombardier are major exceptions.

Governments, both at the federal and provincial levels, have sometimes attempted to take the lead in the application and transfer of technology. Their record has been dismal. This is because the avenue most frequently chosen has been to attempt to pick technological winners while paying very little heed to the dynamics and requirements of the markets. They did it either by subsidizing the development of particular technologies or by directing Crown corporations to do so. The Telidon and Candu reactor fiascos, as well as the mess created by shortsighted government policies and Via Rail mismanagement of the LRC trains, are cases in point. In fact, rather than enhancing our technological competitiveness in world markets, these government initiatives have provided us with models of failure. Such failures are certainly not conducive to establishing entrepreneurial models of success that would foster positive attitudes towards science and technology. As a consequence of these shortcomings, the structure of the Canadian economy is deficient in terms of its created comparative advantages. The Canadian world export share of R&D-intensive products has remained stable at around 4 per cent, while Japan, for example, has increased its share to 16 per cent. World-wide demand for technology-intensive products is accelerating. Advanced economies are diversifying their exports in an attempt to capture a share of this growing market, whereas Canada is keeping to its traditional economic base, a base that is facing increasing challenges in its traditional export markets.

In a nutshell, we are behaving as if we had accepted a situation of technological dependency. This need not be the case. However, to chart a new course, we must adopt new attitudes towards science, technology and technological progress. We must put in place a national infrastructure that will sustain our capacity to innovate.

From now on, competition among advanced economies will be knowledge-based, through organizational innovation, product innovation and technological innovation. To succeed, we need a concerted effort that transcends our industries and public institutions. Three major thrusts must direct our national efforts. First, we must significantly raise the overall quality of education. Second, we must increase considerably both the quality and the quantity of research activities performed in Canada, particularly in our best universities. And third, Canadian business people must learn not only to manage innovation, but also to manage with innovations.

"The ABC of a science and technology policy begins with a strong commitment to quality education."

"If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might have viewed it as an act of war." This strong statement was recently made by the United States President's National Commission on Excellence in Education (the Gardner Commission) report entitled "A Nation at Risk." Since the publication of this report, virtually every state has undertaken a study of the quality of education they offer. Moreover, several institutions, from the Massachusetts Institute of Technology to the Carnegie Foundation for the Advancement of Teaching, have tackled the issue. (The Education Commission of the States has counted 184 such entities busily at work.) The Americans are not alone in fearing that their quality of education is not high enough. Similar attempts to improve the quality of education have been undertaken in France, Britain and Japan, to name a few.

The fact that Canada is not presently engaged in in-depth public evaluations of the quality of education provided by high schools and post-secondary institutions is revealing. It tells a lot about our *insouciance* and inability to grasp the fundamentals of the challenges confronting our society. The evidence supports the view that if there is one country that should be concerned with the quality of education it provides, it is

precisely Canada.

The quality of education, as measured by numeracy and literacy at high school levels, has deteriorated. The trend is even more disturbing in light of the relatively weak performance of Canada compared to other countries. International studies indicate that, on average, Canadian students do not fare favourably in comparison with students from other countries. For example, studies of the achievements of high school students in algebra and calculus for fifteen countries show Canadian students to be low to medium performers as compared to students in Japan, England, Belgium and Sweden. Preliminary results of the second international study of achievement in mathematics suggest that students from two provinces (Ontario and British Columbia) performed slightly better than average but well below students in Japan, France and Belgium. Similar studies reveal that, while French Canadian students score above average at the primary school level, their scores fall at least 20 per cent below the international average from about the middle of the secondary level. The suggested explanation is that the relative lack of depth and intensity of science programs at the secondary level in Canada deprives students of the opportunity to gain a comparable level of scientific instruction.

Another sad fact is that close to 30 per cent of all Canadian youngsters drop out of school before obtaining a high school diploma or its equivalent. Furthermore, enrollment rates drop sharply in most provinces as youngsters pass the compulsory school-age requirement. By contrast, Japan's drop-out rate has fallen from 29 per cent in 1965 to 4 per cent in 1980.

These are serious shortcomings, not only in terms of wasted personal opportunities for our young Canadians, but also for Canada as a whole. Need I remind you that the one variable that explains Japanese economic pre-eminence is not MITI (the Ministry of International Trade and Industry), not mythical industrial strategies, but the quality of their work force. And what explains that? The verdict is unanimous: the quality of Japanese schools. And yet, they remain genuinely worried about educational quality, as evidenced by the establishment of the Japanese Excellence Commission.

It is interesting to note that in Japan, the most prestigious annual recognition sought by all manufacturers is the Deming Award. W.E. Deming was an American statistician who first introduced the concept of total quality control to Japanese industry. And why is it that his name is not familiar in North America? Well, Deming attempted to introduce the concept in America, but our work force did not possess the necessary training in arithmetic and statistics to grasp the concepts and apply them to the situation in their plants. By contrast, the Japanese work force had no such difficulty and quickly made the most effective use of Deming's ideas.

This is one difference educational quality brings to the competitiveness of a country.

Public policy must encourage a pattern of educational development that sustains complex jobs and long-run productivity gains. The ABC of a science and technology policy begins with a strong commitment to quality education. And in the modern world, this means strengthening and extending our typically meagre science, mathematics and technology core to give our students a strong science foundation.

The poor quality of education at the high-school level has many unfortunate consequences, one of which is to denigrate mathematics and natural sciences in the eyes of young students. Although Canada has achieved remarkable success in meeting its objectives of accessibility to university — the proportion of 18 to 24 year-olds enrolled in universities is second only to the United States among all industrialized countries — the distribution of undergraduate enrollment in universities poses a number of problems insofar as science and technology are concerned. Not only do we fare less well in science and engineering, but also the proportion of undergraduate students in science and technology remains stable at a time when Canada is facing competition from nations that have made science and technology a major component of their development strategies. Enrollment in graduate studies in the natural sciences and engineering is also proportionately lower than in the United States or Japan. The problem here is not only one of comparison with our competitors, but also one of particular shortages of graduates with advanced degrees in many key disciplines. In addition, at the graduate levels in engineering and science, the problem of quality acquires added dimensions. The Canadian university system offers neither the diversity nor the quality of excellent research-oriented institutions that can be found elsewhere, particularly in the United States.

A major change of direction is called for. The problem is essentially one of attitude. The level of quality achieved by our educational system reflects our expectations. This is where change is first needed.

We would care more about our performance if we knew more about it. I am aware that no subject in education is more intellectually interesting and more fraught with political baggage than testing

— the measurement of the performance of students and schools, the results of which are broadly disseminated. Yet, objective measurement of accomplishment would serve the interests of the students, schools, parents and prospective employers. Properly conceived and administered, such measures would be very useful for diagnostic, prescriptive and certification purposes. Admittedly, there are some timid efforts made in that direction: some university departments are evaluated on a regular basis by calling upon the judgements of panels of experts; professional associations with accreditation powers review educational programs on a regular basis. However, this information is not readily available, pertains more to the input rather than the output and is not systematic enough to provide agreed-upon national benchmarks suitable for international comparison.

"A recent European Management Forum Survey ranked Canadian managers among the lowest of developed countries with respect to the management of technology."

Another conclusion that stems from the foregoing is that education is a problem of national dimensions. Canada is one of the few advanced countries without national examinations. Given our relatively poor record of educational quality, the federal government should provide financial support to independent institutes for research and analytical activities to devise ways of measuring school and student performance and put these measures to use. Recognizing that there is a legitimate national interest in education is not to assert that there is a corresponding imperative for the Canadian government to be interventionist. However, it should use non-obstructive instruments to point the system in the direction that will best serve our national interest. The urgent need to improve educational quality substantially would indicate that the government should make this a priority in its efforts to improve the competitiveness of the Canadian economy.

It is common knowledge that society as a whole draws more benefits from innovation and technological progress than the entrepreneurs and firms that bring the innovation to the marketplace. In other words, the social returns from innovation are higher, indeed much higher, than the private returns. In a recent study, Edwin Mansfield determined that the median estimate for the social rate of return was 56 per cent, whereas the median for the private one was about 25 per cent before taxes. He also found that the difference was directly related to the economic importance of the innovation and inversely related to the cost of imitating the innovation.

These empirical findings have profound policy implications. They suggest that, if left to the forces of the marketplace, there will be substantial under-investment in technological innovation. It also follows that governments are justified — indeed they are required — to make significant public investments in the production of scientific knowledge and the encouragement of innovation. This is increasingly true, because resource-driven international competition is being replaced by opportunity-driven competition, and innovation and technology are at the core of this new form of competition.

That significant public investments in R&D are required to ensure an optimal level does not imply that governments themselves must be engaged in performing it. Too often in Canada, we confuse the desirable focus of the policy with the locus of the activity. Here again, comparative analysis of high-technology policies pursued in major industrial nations provides us with valuable insights as to the most effective directions. For instance, the studies clearly indicate that universities and government laboratories are inefficient in developing products and processes; this phase of the innovation process properly belongs with industry. They also show conclusively that basic research conducted in research universities and generic and pre-competitive research conducted on a collaborative basis with industry are the most promising instruments. Reviewing the evidence, it is also hard to escape the conclusion that general strength in scientific and engineering education and research is a prerequisite for vitality in knowledge-based industries. A quick look at the situation in Canada leads to the conclusion that here again we are missing the boat.

In 1985, federal government R&D expenditures were close to $2.2 billion or 0.5 per cent of GNP. However, two-thirds of these funds was earmarked for activities conducted within its own establishments and approximately 15 per cent was in support of industrial R&D activities. Most of the remainder (about $400 million) was for research conducted in universities. The bulk of

total government funding of R&D in Canada is heavily skewed towards non-targeted, non-industry-driven activities.

In real terms, the funding of research activities conducted by universities is less today than it was in 1970. Not surprisingly, our relative performance has deteriorated over this period. Moreover, we have found that the level of funding in Canada for leading-edge research is four to five times less than what is available in competing research universities abroad. We know that productivity in leading-edge research requires that certain thresholds of size of research teams and funding be met. In Canada, we systematically fail to meet them.

Although some specific industrial sectors have joined forces to address common challenges, there has not, to date, been broad industrial response to generic technologies such as biotechnology, microelectronics, advanced materials and intelligent systems. This is in sharp contrast to the industrial research consortia (university-industry, government-industry) being formed in Japan, Europe and the United States.

Two recent examples will illustrate the difference in approach in this regard. In Canada, the Pre-Competitive Advanced Research Network is the first effort to establish such a consortium. It builds on the pioneer network in robotics and intelligent systems research established in Canadian universities by the Canadian Institute for Advanced Research. The front-end support requested from the federal government is $10 million, to match private sector commitments. They still are awaiting an answer.

"...management and labour should put more faith in technology as a tool to increase productivity and competitiveness."

In the United States, Sematech, the newly-formed consortium to perform generic research and manufacturing development in semiconductor and materials fields will have a total annual budget of $250 million, which includes $100 million a year through 1992 from their federal government; moreover, the U.S. Congress has already approved those outlays.

We must make a commitment to excellence in basic and pre-competitive generic research in Canada. The capacity of Canadian universities to train qualified individuals, produce new knowledge and disseminate this knowledge is fundamental to the future well-being of this country. To this end, there exist strong arguments to support a proposal calling for the doubling of the budgets of universities in basic, generic and pre-competitive research over the next three years and thereafter indexing the growth of these budgets at a rate equal to 1.5 times the rate of growth of GNP.

Increasing the speed of innovation and the diffusion of technology will require considerable improvement in the ability of Canadian management to master technology and use it profitably. Not enough Canadian corporations have learned to master technology as a competitive weapon. A recent European Management Forum survey ranked Canadian managers among the lowest of developed countries with respect to the management of technology. That is a pretty strong indictment.

Technology is a critical component of corporate strategy. Implicit technical choices underpin most corporate strategies, even those that claim not to be dependent on science and technology. In recent years, the nature of competition has made imperative the integration of technical considerations into strategy and the building of distinctive corporate strengths.

Here again, several factors explain our weak performance.

The sizable proportion of foreign-owned corporations in Canada does not help. Generally speaking, they do not perform research and innovation activities in Canada. Consequently, management in such an environment does not learn how to kindle and manage the innovation process. The following assessment by Raymond Vernon is particularly relevant: "Unlike the resourceful Japanese, U.S.-based multinational enterprises generally do not avail themselves of technology developed elsewhere. Americans have the most extensive network for potential technological feedback. Yet these networks are characteristically designed for one-way communication. The subsidiaries take commands from the home office, but the majority of U.S. companies fail to absorb information received from subsidiaries and incorporate it into their operations." Clearly, Canada benefits when advances in technology are transferred to the Canadian establishments but, in view of the fact that innovation is the key to competitiveness in the global market, it is difficult to avoid the conclusion that many in Canadian management are eunuchs.

It is also fair to assert that Canadian schools of management undervalue the importance of science and technology. The technological dimensions of strategies, the management of technical risks and the necessary transformation of human organizations are not stressed. Concerns for marketing or financial risks are given much more weight than the strategic management of technological risks and opportunities. In spite of the interest expressed by deans of management schools on the question of technology management, the problem remains serious.

Openness to innovation is influenced by knowledge. This in turn will greatly influence attitudes. These positive attitudes are shaped considerably by the education we receive in school during our formative years. This is why universities and schools of management, in particular, have a central role to play.

A superior quality of education will make Canada a nation better adapted to change and the information age. More students should be encouraged to take science and engineering. Our education and training policies must provide Canadians with an institutional framework that will give them the opportunity to retrain and re-school, thus giving them the tools not only to cope but also to benefit from advances in technology. Basic generic and pre-competitive research should be strengthened, particularly in our universities. And finally, management and labour should put more faith in technology as a tool to increase productivity and competitiveness. We must recognize that our poor performance today is partly attributable to shortcomings in the abilities of the Canadian managerial class which, on average, has little experience with the in-house management of innovation. This can be corrected, particularly through better management education. These few propositions should constitute the core of our national strategy in science and technology.

Some might be surprised that I have not given more importance to high-tech industries. There is no doubt in my mind that high-tech industries, despite their small size, support the economic activities of a country. These industries may not be the main factor behind economic growth, but they do act as a catalyst for growth by invigorating the economy. But for this to happen, the bulk of our economy must be receptive; it must be prepared to incorporate these new advancements in product and process technologies.

Discussing this very issue, Yutaka Takeda, former president of Nippon Steel, recently said: "It is correct to describe the brain as the most important part of the human body; yet neither the head nor the body can live if the two are separated." I would add that it contributes a lot to performance when the body is in shape and intellectual capacities are well-developed. Canada is not in good shape to compete successfully in the new world economy. I do not believe we are suffering from a crippling and incurable illness. However, like the human body, the more we wait to get back in shape, the longer it will take to achieve this goal and the greater the likelihood that we will fall sick.

For these reasons, I believe that our priorities must centre on developing a national infrastructure that will allow us to compete successfully as a knowledge-based economy. We have a lot of work ahead of us. As you go into the workshops, I would like to leave you with this thought from a Canadian writer, Monseigneur Félix-Antoine Savard: "Nous avons beaucoup mieux à faire qu'à nous préoccuper de l'avenir; nous avons à le préparer."

DR. NORMAN KEEVIL

CHAIRMAN
TECK CORPORATION

Dr. Keevil's distinguished academic career and broad research interests led to membership in many professional societies, including the American Chemical Society, the Society of Exploration Geophysics, the American Geophysical Union and the Association of Harvard Chemists. He is a Fellow of the Geological Society of America.

In 1947, Dr. Keevil began a career in business, as President of Mining Geophysics Corporation. He later acquired control of five established mining companies and substantial shareholdings in a number of others. In a continuing cycle of consolidations, new acquisitions, and an aggressive exploration and development programme, he brought the Keevil Mining Group, now Teck Mining Group Limited, to a major position in the Canadian mining industry.

Dr. Keevil is a Director of Cominco Ltd. and other companies, and Chairman and President of Moli Energy Ltd. He is a member of the Science Council of Canada, and in 1986, he was appointed an Officer of the Order of Canada.

INTRODUCTION TO WORKSHOP SESSION A

REVITALIZING ESTABLISHED INDUSTRIES

JANUARY 13, 1988

This session will focus its attention on established industries and on how technology can be used to upgrade them to meet the intense and sustained international competition in the years ahead.

The title of this session, Revitalizing Established Industries, should not be taken to mean that Canada's established industries have somehow become "devitalized" or that this country's industrial base has lost its vitality. Such a broad generalization could not be further from the truth. Within many established industries, there are companies that have bright prospects. Others may well need revitalizing, but that is nothing new — it has been true throughout my career. Revitalizing in these cases may mean nothing more than new management, an infusion of capital or an infusion of technology.

After the last recession, the Canadian mining industry at large needed revitalizing, but it did not suddenly become a sunset industry. There had been so much vitality in the preceding years that many companies incurred far too much debt and became vulnerable to the problem of low prices. As we stand here today, debts have been reduced, prices have improved and we have a healthy industry.

Too much is often made of overproduction from developing countries and increased competition. Certainly an excess of productive capacity was built up prior to 1981 in many industries, but this was true around the world and was not restricted to developing countries. The excess of zinc smelting capacity became a problem in western Europe and perhaps in Japan. Canada created excess capacity in potash. Excess capacity in coal lies in Australia and in Canada. This is also true in other areas such as forest products. Excess

capacity is being whittled down and, in some cases, has disappeared, at least for now. The solution is in sustained economic growth, so that demand meets the ability to supply, and growing demand can justify additional productive capacity.

Canadians can compete in a world where trade and competition are growing, because opportunities are growing too. Canadian mining expertise is something we export to the rest of the world, and our mining industry has competed in world markets for decades. As new technology is developed, true, this helps our industry, but it is something that is generally quickly adopted around the world, so everyone benefits.

"Canadians can compete in a world where trade and competition are growing, because opportunities are growing too."

In the United States, the Phelps Dodge Company, for example, was revived by application of a new technology. Instead of merely retrenching further, the company chose to alter the make-up of a significant share of its copper production from conventional sulphide concentrates and smelting to leaching copper oxides, producing high-grade copper through solvent extraction and electrowinning. This played a significant part in the revitalization of this major American copper producer which had racked up losses of $400 million U.S. in the 1982-1984 period, when some stock analysts could not see the survival of the company. Phelps Dodge is now not only in an enviable earnings position, but also it has ensured its economic viability for several decades into the future through the utilization of solvent extraction/electrowinning technology for the production of copper.

As I said, other companies soon benefited by moving into this type of copper production, and I suppose the ultimate sign in the quick movement of technology is the recent announcement by Codelco of Chile that they will be building a 52,500 tonne/annum solvent extraction/electrowinning plant to tank leach old tailings at their Chuquicamata division. Of particular note is that this is a Third-World producer moving to new technology and adapting it to tailings, rather than the primary mining of an oxide. Of course, while mining moves elsewhere quickly, this is not so in all industries.

In Canada too, Cominco's new zinc smelter is state-of-the-art and the lowest-cost zinc producer in the world. Our lead smelter is presently being brought up to a similar standard with government assistance. New technologies developed at their research centres are exported to others in Canada and to various parts of the world — Ghana, Mexico, Korea and Australia.

Black & Decker Company substantially improved its productivity in the manufacture of power tools by designing products for production using new materials and new manufacturing techniques, reducing the number of parts, and standardizing components — linked to new technology. That allowed them to become a high-value, low-cost producer in some lines of small power tools.

The success of Black & Decker's program raises the possibility that production of many mature products could be revolutionized by attention to design for improved manufacturability.

These are just a few examples of what some major companies are doing to revitalize industry. However, other established Canadian industries rely heavily on importing technologies and know-how. This is particularly true of branch-plant corporations which rely on their parent corporations, usually through a royalty or licensing arrangement. There is nothing wrong with importing technology, because it may be the most efficient means of getting needed new technology.

Canadian corporations as a whole have failed to reinvest an adequate portion of their earnings in research and development. This strategy is a way to get started, but it is certainly not the optimal strategy where there is intense international competition and rapid technological change. Too few established Canadian corporations are managed by people who appreciate this changing requirement.

As to global linkages, it is worth noting that the mining industry already has many international linkages such as our own with Australia and West Germany. In what is becoming a global financial community as well as a trading community, such linkages may be a model for other Canadian sectors.

Most people think of R&D as being electronic, chemical or biological research. I prefer a much broader definition. In our industry, for example, we do many of the things conventionally considered R&D, such as developing computer applications to improve mining or process control, metallurgical research, even working with bugs to extract metals. But our most important R&D in the broad sense is exploration. This includes trying to develop better tools, but it also includes the actual exploration expenditures we have — in the tens of millions for some companies; these are really akin to R&D, although not generally accounted for as such. Just as IBM spends R&D funds to try to have a new product ready when its old one is not competitive, mining companies spend exploration dollars. It doesn't sound as exotic, but it is the same.

Other groups in the conference will be covering R&D and the importance of tax incentives to encourage expansion. I am sure that this will be emphasized. But let us focus on R&D for a while. Where does it start and who does the work? It begins within our universities, which produce the highly trained people who do the work. It will not be easy to keep up. We must train our people in the new ways, but education and not training should be our goal. Trained people can follow, educated people can lead.

"There is nothing wrong with importing technology, because it may be the most efficient means of getting new needed technology."

Our universities will play a central role in this process. One might ask whether our educational process in Canada is as good as that in the U.S. or Japan. I would say at the undergraduate level, yes, but I would question whether that is so at the graduate and research level. Yet this is where we have to be competitive to be at the leading edge of science and technology. From my own experience, I would say that we don't have in Canada anything to compare with what the United States has at Cambridge, with Harvard and M.I.T. side-by-side, or with the universities in California. At Harvard and M.I.T., there are experts in nearly every technical field who are accessible and helpful and provide a stimulating environment.

Akin to the Marshall plan, which helped Germany become an economic superpower, perhaps we should have a Mulroney plan to advance technology in Canadian universities. Together with industry, we should develop in Canada a major technical institute like M.I.T. in association with a major university that has the talent and the space — perhaps two, one in the west and one in the east. When I was at M.I.T., the Arthur D. Little Company — which most of you would know about — was part of the Institute. Later, it became a separate entity, working with existing companies and spawning new ones.

It may cost billions to do this but less if advantage is taken of existing space and facilities. Adding to debt in this way would benefit our children and our grandchildren, unlike debt arising from social programs whose costs exceed our ability to pay.

Whether this is done or not, I think that the key to increasing Canada's technological base lies in the availability of adequate numbers of highly trained and well-educated people. I do not think that a talent pool of appropriate size is presently available in Canada in certain disciplines.

I believe that the absence of a manpower pool of suitable size is a serious impediment to increasing our technological base. We all should ensure that young people seek higher levels of education and that they are not inadvertently encouraged into areas that are unlikely to produce adequate returns for the taxpayer.

As to federally supported projects, I would suggest that these should be more selective, fewer in number and better funded. Perhaps the various workshops can decide who should make such decisions. They should be at the leading edge of science and practical enough to promise early economic returns.

I can mention one of my own R&D projects, first rejected by NSERC (the Natural Sciences and Engineering Research Council), which I recognized as being promising and first funded myself. That is Moli Energy's Molicel, the world's first rechargeable lithium battery. Starting from a group of three in 1978, this progressed from the university to a small lab, to a large pilot plant, finally to manufacturing today. This was a technological breakthrough of enormous importance to electronic, communication,

technological breakthrough of enormous importance to electronic, communication, photographic and video devices being developed and under design. Moli also has electric vehicle capabilities. This project is now being supported provincially and federally in order to keep this leading technology in Canada.

Once an idea or program has been identified as having major economic promise, a great deal of additional funding is required before this promise can be translated into an economic benefit for Canada. Federal programs should be established which would allow for follow-up support of the best of the research projects to the point where they are fully developed. I look forward to hearing what Minister de Cotret says on this. This sort of funding should be in proportion to the ultimate economic benefit that can be expected from the proposed development. Without such follow-through support, even the best projects may ultimately falter. Japan doesn't let promising projects lie on the shelf. When the breakthrough in superconductivity was made last year, they immediately allocated some hundreds of millions for research in that field.

"...the key to increasing Canada's technological base lies in the availability of adequate numbers of highly trained and well-educated people."

How can we compete? Establishing commissions or other bureaucratic studies is not the way. Perhaps we should find another C.D. Howe and create another milestone in Canadian industrial and technological development. This may be something of an exaggeration and not feasible today, but I want to make a point. In business, we do not get ahead by having endless conferences and unnecessary paperwork but, after reaching some sort of consensus with colleagues, we get ahead by boldly taking the initiative, taking advantage of opportunities as they arise and making quick decisions. If we don't, we just fall behind.

In summary:

1. People are the key to revitalization. We must train and educate our young people, including women. We should consider establishing a world-class science centre to include technological institutes to provide advanced engineering training and the atmosphere to encourage research in new technologies.

2. We must be selective. We have limited resources that cannot be spread 1 mm thick across this vast country.

3. Revitalizing is a continuous process, and business is doing it all the time.

4. Lastly, let's not go overboard on revitalization. We are world leaders in many disciplines, including mining, communications and engineering. However, we can't rest on our laurels. We will have to work to keep ahead where we have the lead.

I have strayed somewhat from the theme outlined for this conference, but I hope that, with these few provocative thoughts, rather than conventional wisdom, this session can develop new ideas and new possibilities, not all of which we may agree upon, but ideas which will stimulate thought. Of course, the best outcome would be to come up with a few concrete proposals for immediate action, rather than have decisions held up until further studies have been completed.

THE HONOURABLE

ROBERT R. DE COTRET

MINISTER OF REGIONAL
INDUSTRIAL EXPANSION AND
MINISTER OF STATE FOR SCIENCE
AND TECHNOLOGY

ADDRESS

JANUARY 13, 1988

[English]

In future years, we will surely look back on this conference as one of the memorable events of the 1980s.

Canada's industrial achievement into the next century will be led by the people at this conference, and I am happy to have the opportunity to work together with you in building an industrial economy of the future, for the future.

[Translation]

I want to take advantage of this unique opportunity to describe to you what amounts to a fundamental departure in federal government policy and organization. We have embarked on a major effort to redefine the role of the Government of Canada with regard to industry, science and technology. The objective is to meet the challenging new environment confronting Canada and the industrialized world now and into the 21st century.

[English]

Already this afternoon, the Prime Minister has singled out the main features of the challenges we face. I won't repeat his observations. But I will repeat the imperatives.

In the future, we Canadians will no longer be able to sustain our wealth, well-being and economic development solely only selling off our natural resources.

We will not be able to progress, or even hold our place, if we are unable or unwilling to come to grips with an international trading environment in which all the newer products Canadians buy are produced in Japan, Korea, Taiwan, the United States or elsewhere.

As a nation, unfortunately, we have fallen behind the industrialized world in terms of our ability to develop, acquire and apply the very latest innovative technological processes and materials to keep our place as a leading industrialized nation.

Canada came out of World War II as the fourth largest manufacturing nation, after the U.S., the U.K. and the U.S.S.R. Now we have lost ground.

The planned and systematic research and

development that came with the war years increased in peacetime, and Canada became a leader in certain technological fields, such as nuclear power, aerospace, fibre optics and digital data management.

Despite these recognized successes, our overall industrial technology performance has not been good. It has not been good enough to keep Canada in the forefront of industrial economies.

[Translation]

Canada has to regain its technological edge. We have to work harder and smarter to keep up in scientific research and maintain research and development. We have to acquire and apply technological advances to our products and production methods. We must be more successful in raising the consciousness and inspiring the efforts of Canadians to exploit to the full the talent and resource potential that we once displayed but are rapidly losing. We have no choice but to mobilize our national productive effort along the path of excellence.

We must and — I am saying to you today — we will establish a Canadian industrial and scientific base capable of competing internationally in a new world economy characterized by rapid technological advances, where not only materials and production methods, but also the very products people demand, change with blinding speed.

[English]

But excellence in science and technological development alone is not enough. The time it takes our competitors to move ideas from the laboratory to the shop floor and from the shop floor to the department store has shrunk. We have to change our ways of doing things to become competitive again. Science and technology should form a seamless ribbon with other elements of successful business practice, running all the way from the laboratory to the retail outlet. It's not a question of building bridges; it's a question of building a continuum. Our industries have to have the capacity to move a product from its very initial stage through to production at an ever-increasing pace, while maintaining quality and cost. They need strategic and financial planning capable of managing rapid change rather than reacting to it. Real marketing excellence in a trading environment knows no international or cultural limits. We must ensure that Canadian industries acquire and use it.

[Translation]

In short, our scientific and technological efforts can only be effective if they are accompanied by agility, flexibility and adaptability in the global marketplace.

Governments are not capable of achieving these demanding goals alone. But governments do have a definite role to play in their achievement.

"Science and technology should form a seamless ribbon running all the way from the laboratory to the retail outlet."

[Translation]

While past Canadian governments have never devoted sufficient attention and resources to the issue, let me assure you today that this government is determined to assign top priority to the revitalization of Canada's industrial, scientific and technological effort — to get Canada back into the forefront of industrial excellence.

[Translation]

A major milestone was the Prime Minister's announcement on August 4 last year of the creation of the new Department of Industry, Science and Technology.

I want to spend the remaining time available explaining what this new department is all about.

The first and most important thing to be said about the new department is that it constitutes a fundamental break from the past.

[English]

Let me try to put the raison d'être of the new department in one sentence. My new department is the department that will speak to, for and about industry, science and technology in the Government of Canada.

Here is how I see the department shaping up in light of this mission.

I am determined that the Department of Industry, Science and Technology become an effective, well-informed and, when necessary, passionate advocate of your interests in Ottawa.

I am well aware of the far-reaching effects on

business and industry of the wide range of government policies. As the Prime Minister noted, there are important linkages between science and technology and other economic and social policies. The Department of Industry, Science and Technology will be a new and major policy department acting as your advocate with other government departments in realms such as taxation, trade, resource development, and the regulation and development of transportation and communications.

[Translation]

We will give attention in the advocacy function to the particular needs and capabilities of small and medium-size businesses. As we all know, small and medium-size businesses represent many of the most entrepreneurial elements of Canadian industry.

In order to be an effective advocate, the department will base its activities on broad and comprehensive intelligence.

We will become very knowledgeable about global and domestic markets, the forces that determine business competitiveness, and the diverse business conditions affecting Canadian industry. We will have a good understanding of competitive forces, the state of technology and international market conditions as they exist and are evolving in all industrial sectors.

[English]

We will seek to ensure the efficiency of Canadian production processes, technological and managerial skill levels, the availability of risk capital, access to markets, and many other factors.

One of the department's first tasks will be to renew the government's knowledge on these subjects and establish the communications channels to develop and sustain a high quality of intelligence. It is upon you here tonight that we will rely as our primary resource in this intelligence-gathering exercise.

With regard to Canada's scientific effort, our government recognizes that the time has come to advocate more investment in Canada's science and technology base.

The Prime Minister, in his remarks earlier today, said: "We must foster a culture of science and technology, so that all Canadians will recognize that science and technology are keys to securing our prosperity and our reputation in the world community."

There are, of course, many reasons other than economic development to pursue scientific research. Research saves lives, enhances our understanding of the universe and achieves many other goals important to our society. Our policies in the new department will recognize this fact.

They will, above all, reflect our overriding commitment to the value of excellence in Canada's scientific research. The Centres of Excellence program announced today by the Prime Minister is a clear beacon of this commitment. It's a clear indication of our thinking in the new department, as we move towards legislation to create it.

While we recognize the intrinsic value of scientific research, we must also remember that there is no aspect of economic development in the modern world that does not depend on science and technology. No doubt I am preaching tonight to the converted, but let me illustrate what I mean.

[Translation]

Scientific breakthroughs since the 1960s have led to dramatic improvements in understanding and manipulating matter, information and processes at microscopic levels. This new ability is the foundation of information technology, biotechnology and advanced materials — a group of technologies referred to today as strategic because they are so critical to progress in a wide range of industries.

"Companies and nations that do not invest adequately in science and technology ... will quickly find themselves spectators at the race."

By capitalizing on breakthroughs as they emerge from laboratories, companies can fundamentally change and customize products and processes and respond quickly to changes in market-determined product requirements. An everyday example is the automobile industry's declining use of steel and other conventional materials.

[English]

Engineers and designers can now prescribe a performance requirement and challenge suppliers to create a material to meet it. Obviously,

suppliers with technological capability will emerge as winners.

Companies and nations that do not invest adequately in science and technology, that are not well-connected to sources of innovation, that do not integrate their industrial, scientific and technological efforts — will quickly find themselves spectators at the race.

The new Department of Industry, Science and Technology will have the mandate to work towards a closer integration of Canadian industry with Canadian scientific knowledge and technological skills. Success in this endeavour will require a concerted effort with the business and science communities. One of the department's principal concerns will be to mobilize and catalyze this effort.

The Hon. Robert R. de Cotret in discussion with Rita Dionne-Marsolais.

The fact that the National Research Council and the Natural Sciences and Engineering Research Council will also be part of my team will assist greatly in our endeavour.

Having described the department's determination to be your advocate in the councils of government and its objective of a closer integration of science and industry, I will now turn to what I propose as the appropriate operational activities for the new Department of Industry, Science and Technology.

Let me say that the new department's activities will reflect this government's commitment to the principle that markets must be allowed to work and that adjustment is desirable and should be assisted, not resisted.

All of the activities of the department will be targeted on international competitiveness and industrial excellence.

One of the department's key activities will be to foster the development of strategic technologies — biotechnology, information technology and advanced industrial materials.

[Translation]

This initiative will be an important point of integration between science and industrial development. It will be led by the new department and will involve other departments, agencies and services in promoting technology diffusion.

Methods to be used could include joint investments with firms and consortia, targeted research at NRC and other government laboratories, increased funding for training of highly qualified personnel through NSERC, and international prospecting efforts to seek out technology needed in Canada.

We will not, however, abandon activities that have been successful in the past. The Defence Industry Productivity Program is one that has, in fact, proven quite effective in assisting technological advance and diffusion in the defence and aerospace industries. We intend to retain it, as it is particularly suited to the new department's mandate.

[English]

Characteristic of the new department and its operations is the intention to focus attention on industrial sectors. In partnership with industry, the department will examine the needs and opportunities of a given sector to determine what must be done to increase its international competitiveness. The various instruments available to the department will be brought to bear in a sector-wide campaign.

Such sector campaigns could range from export promotion drives to programs aimed at technology applications, business and technology information services, or selective investment promotion. Again, I emphasize that such campaigns will be developed in fullest partnership with the industries concerned.

In designing these sector campaigns, special attention will be paid to the unique needs of entrepreneurs in small and medium-size businesses.

The department will also work with Canadian business to promote Canadian enterprise through market development services, including trade fairs, missions, business opportunity sourcing, import replacement drives, export counselling for Canadian producers, brokerage and matchmaking in the international marketplace. It will engage

in investment prospecting, pursue industrial benefits from procurement and provide other similar services to its business clients.

It is intended that the package of programs and services of the department will provide the seamless ribbon of industrial activity I mentioned earlier. This essential element will link everything from what I would call pure curiosity research at one end of the spectrum through academic research, government research, industrial research and activity, and marketing and sales, both domestic and abroad.

[Translation]

The Department of Industry, Science and Technology will maintain offices in each province, which will be a principal point of contact for business — including the small and medium-size businesses which do not have the resources or flexibility for frequent excursions to the National Capital in pursuit of services and information.

These field offices will be the service-oriented delivery arm of the department, providing ready access to its activities. They will also serve as contact points through which we will keep up-to-date on business intelligence and maintain communications with industry.

[English]

To complete this description of the new department's activities, I should also mention that it will have responsibility for Native economic development and for regional development activities in Ontario and Quebec.

The Ontario and Quebec regional development responsibility will be housed in an organization distinct from the new department's industry, science and technology activities so as to ensure their geographical focus.

"We have acted on the principle that regional development programming has to have its roots in the regions affected."

This new approach to industrial revitalization should in no way be interpreted as a diminished emphasis on regional development. Quite the contrary. This reorganization will permit us to maintain and enhance our efforts to support growth and development in some of the most disadvantaged regions of the country.

The revitalization of Canada's industries through science and technology is essential for regional development. We know from bitter experience that lagging overall economic performance in Canada has a magnified effect in the underdeveloped regions. If we do not achieve the goal of international competitiveness for all our industries, it is the underdeveloped regions that will suffer the greatest hardship.

[Translation]

The decision to create the new department should be considered in light of a series of initiatives which the government has taken. We have acted on the principle that regional development programming has to have its roots in the regions affected. It has to be based on the local economies, with their problems and opportunities, and it must be run with the benefit of advice from the people from those regions, who have the most intimate knowledge of what will work, as well as a great interest in making it work.

[English]

That is why we have taken steps to decentralize the federal regional economic development effort through the initiatives that were announced last summer — namely, the creation of the Atlantic Canada Opportunities Agency, the Western Diversification Office and the Northern Ontario Development Program.

The new department and the new regional initiatives are concrete assertions of the government's determination to ensure effective regional growth in Canada.

That is a brief description of the kinds of activities we propose that the new department should carry out.

To sum up, the government has made a fundamental departure in its approach to industrial, scientific and technological development policy in Canada. We are creating a department that will act in full partnership with the private sector, the science community and other levels of government to promote international competitiveness and industrial excellence in Canada; to renew and rebuild our scientific, technological, managerial and production base; and to bring together in a concerted way the talents of Canadians to guarantee Canada's place in the first rank of industrial and commercial nations in the 21st century.

[Translation]

How we will bring to fruition the mandate we have been given will be decided in discussion with you, the key players in Canada's economic growth. The new department will be directed at bringing all of your efforts together with those of the federal government. Everything I have said about the new thrust of the government implies continuous consultation between government and the lead players in the industrial and economic development game.

[English]

Make no mistake about the fact that we are relying upon you as the source of the advice that will direct our efforts. And please understand that when I say our efforts, I mean the joint efforts of all of us. We look to you for your advice in creating new industry, science and technology policies for this country.

Together, we will generate a self-sustaining national thrust, the hallmark of which will be excellence.

I am very excited about the prospects facing us. I am daunted by the challenge that is facing us. But I know you share my enthusiasm. Canadians will thank us for it in the future.

DAVID M. CULVER

CHAIRMAN &
CHIEF EXECUTIVE OFFICER
ALCAN ALUMINIUM LIMITED

In addition to his responsibilities with Alcan, Mr. Culver is Chairman of the International Primary Aluminum Insitute, the Business Council on National Issues and the Canada-Japan Businessmen's Cooperation Committee. He is also a Director of the American Express Company, the Seagram Company and the C.D. Howe Institute. He is a member of several councils, including the International Council of Morgan Guaranty Trust Company of New York, the Advisory Council of the Centre for Canadian Studies at Johns Hopkins University's School of Advanced International Studies (Washington, D.C.) and a Governor of the Joseph H. Lauder Institute of Management and International Studies (Philadelphia).

MANAGING TECHNOLOGICAL CHANGE

KEYNOTE ADDRESS

JANUARY 14, 1988

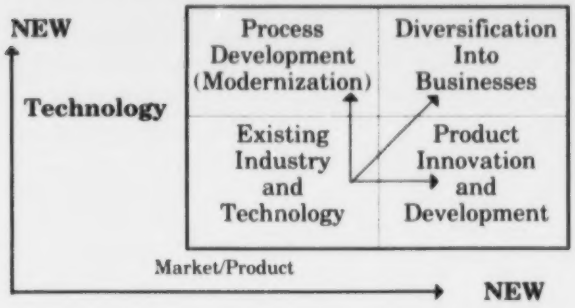
In addressing the subject of technology and innovation, I need not dwell on its importance at this juncture in our country's history. The trading environment that surrounds us and the economic realities that drive this conference have been ably dealt with by the Prime Minister and other previous speakers.

To their comments, I would add only one thought. Technology and innovation are deadly serious matters for Canada. It is easy to acknowledge that technology is the in thing nowadays. Technology is in danger of becoming a motherhood theme. I want to emphasize that technology is not just motherhood. For Canada, it is survival. If technological innovation, as a key competitive tool, does not become an integral part of our everyday industrial thinking, we are in danger of slipping backwards in the world scene and doing so irreversibly. We risk throwing away the momentum in productivity and output that we currently enjoy. We must channel that momentum into new paths, innovative ways, up-to-date technology.

Let me turn now to the main subject of my remarks today. I felt that it might be helpful if I were to address the question of how technology and innovation can be managed in a real-life situation and under conditions of fairly rapid economic and industrial change.

I make no apology for the fact that I shall draw on the experience of my own company, Alcan Aluminium Limited, to illustrate my subject, for I believe that Alcan's situation is in many ways analogous to Canada's situation. Before getting to that, let me first, by means of a simple diagram that tells a complex story, illustrate what I see as the spectrum of technological challenge facing Canada. In a way, it draws together the themes of the three workshop sessions of yesterday afternoon, this morning and this afternoon.

THE DRIVE TO COMPETITIVENESS



Some of you may be familiar with this quadrant form of diagram. The two axes, horizontal and vertical, indicate increasing degrees of newness, greater movement outwards from the existing state of affairs, which is the origin point. Along the horizontal axis is measured the degree of change in market and product demands. Up the vertical axis is measured the degree of innovative and technological change in the industry or the company

The bottom left-hand quadrant represents essentially the current position, the status quo. Like all status quos, it is illusory. Status quos do not persist as competitors find new positions, new products, new tactics. Some action is necessary for survival. As von Clausewitz said, "To do nothing is to do wrong."

As the diagram shows, movement is possible, to a greater or lesser degree, in three different directions. For Canada, the need is for movement in all three. A movement vertically upwards indicates the introduction of new technology into existing industries, the classical approach to modernization and cost-cutting — what yesterday's work session called revitalizing established industries. Here we are in the field of capital investment, computer-driven production and preventive maintenance processes, the world of CAD/CAM and robotics. Bend the arrow slightly to the right, and you include the introduction of management technology such as fewer layers of management for simpler and quicker decision-taking, different work groupings, just-in-time planning, quality circles, the many ways in which human beings individually and collectively can improve output and productivity, as well as the quality of the life in the workplace. We should not forget, however, the social and cultural fallout of modernization, which is almost inevitably a loss of jobs. Here there is a role for government as well as companies in providing relevant and timely retraining opportunities for those who are displaced.

A movement horizontally indicates emphasis on new products and new market applications largely within the context of existing technology — a major aspect of what will be dealt with later this morning under the title "Developing Higher-Value Products and Processes for the Markets of the Future." This quadrant has perhaps received too little attention over the past few years. The major focus has either been on the necessity to cut costs or on the exciting new technologies with their promise of new generations of products. But it is also upon understanding the near-term needs of the market that commercial success depends. We must obviously become cost-competitive on a world basis but, above all, we must offer products that the world wants. This means product development and innovation, at least initially within the technology that we now have. There is much early gain to be made here, as well as by venturing into the less familiar territory of the new technologies.

"If technological innovation, as a key competitive tool, does not become an integral part of our everyday industrial thinking, we are in danger of slipping backwards in the world scene and doing so irreversibly."

Canada needs to move into all of the three new quadrants. Individual situations will call for differing combinations of newness, but they will all have a common denominator. In all cases, these moves are in the direction of a higher knowledge content of products and services, adding to their value and, if well executed, to their profitability. But together with higher volumes come higher risks, and management tasks and rewards must be adjusted accordingly.

Let me read you the statement of Alcan's corporate mission, first published in June 1986. "Alcan is determined to be the most innovative, diversified aluminum company in the world. To achieve this position, Alcan will be one global, customer-oriented enterprise committed to

excellence and lowest cost in its chosen aluminum businesses, with significant resources devoted to building an array of new businesses with superior growth and profit potential. In the 1990s, Alcan will outperform the S&P 400." But let me ask you to substitute the word Canada for the word Alcan, drop aluminum and substitute the word nation for company or enterprise, and let me re-read the statement. "Canada is determined to be the most innovative, diversified industrial nation in the world. To achieve this position, Canada will be one global, customer-oriented industrial nation, committed to excellence and lowest cost in its chosen businesses, with significant resources devoted to building an array of new businesses with superior growth and profit potential. In the 1990s, Canada will outperform the OECD performance index." Not a bad mission statement.

Alcan's mission statement was not thrown together by a backroom copywriter. Behind the statement lay five years of work to prepare people for change and to evoke and test new directions and procedures. The statement itself was the product of many months of discussion, culminating in a week-long meeting of seventy of our senior managers from around the world in June 1986. Each word was thoughtfully and sometimes heatedly debated for its significance and its implications. The week-long meeting from which it emerged was described as "an exercise in common understanding as a prelude to coordinated action" — again a clear parallel to this conference.

"...there is a role here for government as well as companies in providing relevant and timely retraining opportunities for those who are displaced."

Let me now take you through the process — first of planning, then of action — undertaken by Alcan and draw the parallels for Canada. First the overall situation. Like all companies in what has always been largely a commodity business, Alcan has had to face the cyclical nature of demand. But, in addition, largely as a result of the oil shocks of the seventies, the overall growth rate in the world aluminum industry slowed down from a compound rate of 7.8 per cent per annum in the post-war decades to a rate of around 2 per cent per annum now. In addition, the impact of other commercial factors in the early eighties was depressing overall price levels and increasing the gyrations of prices in the aluminum spot market almost to the point of instability. In the case of Canada too, slower world growth, overcapacity, depressed commodity prices — until recently at least — and the adverse effect of price and currency fluctuations are familiar problems, particularly for the resource industries which have been the mainstay of Canada's exports.

Recognizing that low growth and unstable prices had probably become a permanent feature of its economic life, Alcan determined three courses of action.

1. To identify and concentrate on those businesses in which we had a long-term competitive advantage.

2. To ensure that we were cost-competitive on a world basis in those chosen businesses.

3. To move into significant new businesses, based on our strengths, which would give us above-average growth and profit.

A major enabling factor in achieving these changes was our research and development organization, which had been undergoing a major re-orientation of effort. The initial phase was to identify across Alcan's system the best technology in use in a given process and then to transfer it systematically to all production units in the group, sharing peer experience in face-to-face sessions as well as by documented procedures. The transfer of technology was and is an immediately effective tool in raising output and productivity as well as reducing costs across the whole organization. I can't stress that too strongly. We put so much effort into talking about the things that are new that we forget that properly applying the things we already have to what we are already doing is the quickest route to fast cash flow. We did that. In our research centres, programs were being redefined and redirected to create new options and opportunities. All this was done in the early years within a virtually constant cost envelope though — I have to say — with a considerable turnover of individuals. The beauty of this was that we were able to provide the benefits to our operating units without increasing the fees which they paid to the R&D organization — an important element in gaining their support.

In 1980, Alcan's R&D expenditure, including the research organization and operating companies, was close to $40 million U.S. In the research organization, which was responsible for the bulk of the expenditure, 40 per cent was devoted to raw

materials processing and primary smelting, the core process of our industry; 50 per cent was devoted to semi-fabricating processes in aluminum; and only 10 per cent was devoted to new technologies. So 10 per cent of $40 million, $4 million, was spent on new technologies in 1980. In 1988, we shall spend $105 million U.S. on R&D, and almost 60 per cent of it, over $60 million, will be on new business-related technology. The key difference is not in the absolute amount of expenditure, though that has certainly been increased, even in years when our earnings were down. It lies first in the radical change of orientation in the R&D programmes. Second, it lies in the changed attitude towards the role of technology in the company as a whole.

A major problem for the R&D function in an industrial organization is ensuring that its programmes are relevant to business objectives and that they are welcomed as being so by operating managers. Alcan has tackled the first problem on two fronts. We established a technical strategic council, which includes outsiders as well as the four top executives of the company, to advise Alcan on strategic technological direction and the allocation of resources. We also revamped the structure of our in-house laboratories to move them from their earlier focus on process and productivity improvements to that of new product development and the nurturing of fresh markets, in both traditional and new areas of technology. In a sense, those involved in the research and development process have moved downstream and are enjoying a new-found relationship with end-use markets and those who serve them. We are doing things in the R&D area today which would have been unimaginable, unthinkable and probably unspeakable seven or eight years ago.

At the same time, Alcan's mission statement identifies innovation, at all levels in the company, as a key ingredient for success. This thrust to innovation, not only in product and process, but also in the way we solve all our business problems, makes a receptive climate for the emergence of technology as a major driving force. It makes for a common culture throughout the company, based on openness and trust, that is enormously productive. I may add that it is one which is not always to be found in large multidivision companies.

"We need to achieve a public state of mind in which everyone values innovation."

The magnitude of this change in corporate culture should not be underestimated. To move from a largely production-driven organization, good at volume production of a single range of materials, to a customer-oriented one with entrepreneurial strategies, committed to innovation, means changing attitudes on a large scale as well as reallocating resources and re-orienting policies. This is not easy in a work force of 60,000 people spread over 24 countries. One great benefit of the highly participatory meeting from which the mission statement emerged was the commitment and the excitement which each of the 70 managers took back to his country and his company. The other was the evolution of what we call the courage-to-manage concept in the new framework of a slimmed-down management, committed to innovation. This courage-to-manage concept requires a greater preparation to take conscious risks and, with it, a greater tolerance of failure. It requires increased trust in others' decisions, not setting guards on guards in the decision-taking process. It is all part of a new and different culture and a new and different Alcan.

This recognition of research and technology as major team players in this new culture is important. Technology is of little use unless it is relevant and unless it is applicable. The closer you can link the research people and their programmes with the development people and their know-how and with the marketing people and their market savvy, the more effective you will be. The results can be very exciting, as we in Alcan are finding out. Excitement is contagious. Innovation breeds excitement and excitement breeds innovation. Both breed excellence and an entrepreneurial spirit.

If you will reflect on what I have been saying about Alcan, you will see in it a parallel message for Canada and especially a message for this audience.

Canada does have a technological mission statement. It is the National Science and

Technology Policy statement, signed in March 1987, supported by InnovAction, the federal science and technology strategy.

To help turn those strategies into action, Canada, like Alcan, does have its strategic technical council in the Council of Science and Technology Ministers and the National Advisory Board on Science and Technology, chaired, as you know, by the Prime Minister.

But it is in turning those action plans into real progress that the true challenge lies. Government, federal or provincial, can only do so much. It can stimulate, it can provide a framework. But the thrust must come from the private sector. There are, I suggest, a number of things that each of us can do.

1. Rigorously analyze and decide: a) which kinds of business we can stay in and be competitive in over the long haul, and b) which kinds of businesses we should move into and successfully compete in, based on the strengths we have.

2. Reduce and hold down costs by all available means, which means good management as well as the transfer and introduction of appropriate technology.

3. Seek out from all available sources the technologies we need and devise the best means to acquire them. Joint venturing, licensing and managing your own research — each has its own advantages.

4. Organize so as to allow our research scientists, development engineers, operations people and market specialists to work together as closely as possible. Change our organizations' value systems and, if necessary, our reward systems to focus on innovation, individual and shared, in all areas and at all levels.

5. Stimulate within our own organizations and in the general public enthusiasm for technology and excitement about innovation. We need to achieve a public state of mind in which everyone values innovation. There is a place for everybody, from school children to old-age pensioners, not just scientists and high-tech entrepreneurs.

Canada is already better at technological innovation than it gives itself credit for. In a number of areas — communications, robotics, mathematics, software, advanced materials, biotechnology — Canadian firms are world class. Let us not sell ourselves short. We recognize the need. We have the skills. We must define the means. That is why we are meeting here for these three days. Then we must go out and put the ideas into action, steadily and with determination, for success will not come overnight. But it can be done. In a very small way, I have seen it done in my own company, and I am convinced it can happen for Canada.

When we were younger than we are now, we used to use the greeting "hey, what's new." It would be great if, as a result of this conference and other things, Canadians would go back to using that expression, only with a much deeper and more serious meaning to the word new.

Lastly, I read a definition of leadership recently which has stuck in my mind. This person defined a leader as someone with a poorly developed sense of fear and a clear vision of the future. In this field of technology and innovation, let's all be that kind of leader.

DAVID J. HENNIGAR

DIRECTOR
BURNS FRY LIMITED

Mr. Hennigar is Director and Chairman of Crownx Inc. and Director and Vice-Chairman of National Sea Products Limited and Scotia Investments Ltd.

Mr. Hennigar is also a Director of Annapolis Basin Pulp & Power Co. Ltd., Crown Life Insurance Co., Extendicare Health Services Inc., the International Institute of Transportation & Ocean Policy Studies, Cobi Foods Inc., Crowntek Inc., Halifax Developments Limited, Polyvoltac Canada Limited, the Institute for Research on Public Policy and other organizations. He is a member of the Halifax Club and Governor of Dalhousie University in Halifax.

INTRODUCTION TO WORKSHOP SESSION B

DEVELOPING HIGHER VALUE-ADDED PRODUCTS AND PROCESSES

FOR THE MARKETS OF THE FUTURE

JANUARY 14, 1988

Our next session deals with the problems associated with creating higher value-added products and processes for the markets of the future. There are some questions provided in the second chapter of the paper titled "Forging Our Future" which you may all have considered. I trust that individually you will be able to raise many additional questions as well as provide the Prime Minister with answers as you focus on what we need to do and how we can move products up the value-added curve.

In the material that you were supplied with, these questions are grouped around three main themes — the logistics problem, the institutional skills required and lessons from others. For example, what do they do differently that we can learn from in Japan, Germany, Britain, Italy or, for that matter, the United States about such things as listening to customers, incorporating quality into the design of products and developing strategies such as zero defects?

In a meeting yesterday with your group leaders, additional thoughts for organizing your discussion were agreed on, including identifying the market, the customer and what he requires; determining what resources and technology are required to fulfill market requirements; assembling the capital, resources and people to accomplish the task; and how to foster positive attitudes for their successful implementation and resolution. These are the areas around which we would hope you would structure your discussions this morning, and we would encourage you to try to provide specific solutions and recommendations.

Let me turn for a minute to some views and thoughts pertaining to Canada's position in the world. Despite the recent decline in the value of North American dollars, in overseas marketplaces, Canada's competitiveness problem is continuing to grow. Our budget deficit indicates that we are borrowing rather than paying our way. An increasing number of countries are passing our standard of living

without resorting to our heavy levels of deficit financing. With changing demographics, indexed pensions become a ticking time bomb for future generations. The Germans, for example, have a federal law which prohibits any form of indexing, born from experience.

"The challenge to innovate requires that management labour and government create the organizational skills needed for building companies that can compete in global markets."

The challenge for the future has been stated succinctly by Brian Schofield and Robert Thomson in their discussion paper: "Successful business strategy is based on a simple premise. A company can compete and earn attractive returns for its shareholders if it provides products and services to its customers at sustainably lower costs than its competition and/or creates products or services that add greater value to its customers than those available from the competition." The challenge to innovate requires that management, labour and government create the organizational skills needed for building companies that can compete in global markets and develop products that are superior to those of our international competitors. Obviously, the recent trade agreement with the United States will expand Canadian markets and heighten our ability to compete on a world scale. New strategic approaches which incorporate the use of technology are required.

Many of you will recall the battle that we waged at National Sea Products in mid-1985 for a licence to acquire Canada's first factory/freezer trawler, a 30 year-old world technology, in order to provide our customers with higher-quality products which they were demanding and receiving from our competitors in other countries. An interesting result of this is that, by the summer of the past year, with the factory/freezer trawler, we were getting a premium price not only for our codfish but also for redfish, a previously underutilized species. And it's even more interesting to note that the Japanese, basic consumers of this redfish, have established our redfish as the quality against which they measure all their other purchases from around the world. In turn, this has enabled National Sea Products to develop an enhanced relationship with these new customers and a new Asian export opportunity for our other products.

As a nation, we should consider how to exploit and build on our strengths. Not only do we have a rich natural resource base in minerals, forest products, fish and fresh water (25 per cent of the world's total supply), but also we are leaders in areas such as communications, transportation and long-range hydro transmission.

I hope you will review how science and technology can be used to revitalize existing industries and develop new value-added products and processes. Another case in point which pertains to National Sea was the problem of how to provide the processing plants with a higher percentage of premium product from the trawlers. The solution was found in Europe by adapting a containerization process that we call boxing at sea, which reduces the handling of the fish and results in an increase in quality. The solution required cutting the ship in half and adding 21 feet of new steel. Our first conversion was done in Iceland, since no Canadian shipyards had acquired the technical capability to do this. As a condition of that contract, we acquired the right to the technology, and all subsequent conversions have been done in Canadian shipyards. In order to encourage the crews to support this program, their compensation was changed to reward them for increased landings of higher-quality fish, which were then utilized in producing higher-margin, higher value-added products for the marketplace.

I'm sure that all the groups will give ample consideration to the standard operating problems of large and small companies and that some beneficial suggestions will result to deal with such areas as tax policy, financial structure, legal and regulatory hurdles, and the need for adequate

capital in small start-up companies. These factors often inhibit their growth, staying power and consequent success.

Your mandate this morning is to focus on what we can do and what we can suggest government can do to help move products up the value-added curve, thereby improving Canada's competitive position in the global economy.

EDMUND B. FITZGERALD

PRESIDENT AND
CHIEF EXECUTIVE OFFICER
NORTHERN TELECOM LTD.

Mr. Fitzgerald is a Director of Bell Canada Enterprises Inc. He is Chairman of the Committee for Economic Development, Washington, D.C., and a member of President Reagan's National Security Telecommunications Advisory Board and the Council of SRI International. Mr. Fitzgerald served for three years as Vice-Chairman of the Industry Advisory Council of the United States Department of Defense. He is also a co-founder of the Milwaukee Brewers major league baseball team.

THE COMPETITIVE USES OF TECHNOLOGY

KEYNOTE ADDRESS

JANUARY 14, 1988

Right up front in this discussion, I would like to emphasize that the two terms, technology and innovation, although frequently joined together in speeches and papers, are related but distinctly different resources. Technology relates to scientific knowledge and the uniqueness and quality of an individual's, an organization's or a nation's inventory of such knowledge. Fortunately, the North American continent still enjoys the world's largest inventory of new scientific knowledge and continues to generate it at a rapid rate. Unfortunately, in today's world of vastly improved communications, new scientific knowledge travels quickly, globally and in a manner that constantly shrinks the window of comparative advantage to the innovator of new technology.

Innovation, on the other hand, is the conversion of new technology into what I like to call conspicuous customer solutions and can involve either product, process or service. It is this matching of new technology to the solutions of problems (many of which may not even be apparent as yet to their ultimate beneficiaries) that constitutes the process of innovation. Innovation requires enlightened problem definition, coupled with an adroit choice of appropriate technology or new scientific knowledge. Since comparative technological advantage rapidly erodes with time, innovative advantage is therefore also time-based. Thus, the faster the innovative reaction to an economic opportunity, the larger the potential reward.

Although distinctly different resources, technology and innovation are both products of research and development. Although different skills may be utilized in creating new scientific knowledge and in innovatively applying it, both are equally valuable. Thus, the process of research and development is of vital importance to individuals, organizations and nations. The effectiveness of these research and development efforts will determine, to an important extent, the global competitiveness of both companies and nations and must be a high priority in public and private-sector planning and investment activities.

In this regard, I was very pleased to note the comments made yesterday by the Prime Minister, emphasizing the importance he attaches to R&D

and the actions he has taken or contemplates taking to reinforce the effectiveness of research and development in Canada.

In my discussion today, I am going to use Canada and North America as virtually interchangeable terms. I will do so because I believe the problems and opportunities related to technology and innovation extend beyond national boundaries. Adoption of the free trade agreement would make these problems and opportunities virtually identical in Canada and the United States.

In today's global marketplace, North America may still lead in the ownership of technology or new scientific knowledge. But in many product, process or service applications, its lead in innovation has been seriously eroded, if not already surpassed. With a general global awareness of most commercially relevant scientific knowledge, time is now the gating factor in measuring the degree of innovative competitiveness.

"Too often we confuse highly competitive markets with closed markets."

In addition to the introduction of time-based competition, national or domestic markets have rapidly been replaced by a global market populated by aggressive competitors prepared to seek sales revenues, natural resources, components or finished products, human resources, technology, or financial resources from any area in the world in which they can be obtained at a comparative economic advantage. The combination of these two dynamic forces challenges the basic concepts on which many of our companies and industries have relied for many, many years. However, this combination of new forces also represents the kind of environmental change in which alert and innovative participants can significantly improve their competitive posture.

Environmental change, whether it be technological, market structure or regulatory in nature, is the stuff of which competitive challenge is made. Our reaction to this new environment will determine whether we — as individuals, companies, nations or continents — shall be numbered among this new breed of winners, numbered among the breed most kindly described as survivors or classified as the 20th century breed of dinosaur.

Every modern economy is subject to continuous change due to improvements in technology, variations in the factors of comparative advantage and changes in consumer tastes. Unfortunately, there are natural tendencies in both our public and private sectors to resist these environmental changes and to remain with the status quo.

But change ultimately does occur, and it occurs when its pressure can no longer be contained by the system. When this happens, the torrent of discontinuity is tumultuous, and the adverse consequences to those negatively impacted needlessly severe. Rather than resist the natural flows inherent in a market economy, one of our major responsibilities is to work towards a reduction in inhibitions to the movement of capital, labour and other resources towards the most promising prospects for producing growth and away from activities in which such opportunities have declined. An appropriate macroeconomic policy that creates a facilitating environment for economic growth will not in itself assure Canadian or North American competitiveness. Those of us in the private sector must use such a facilitating environment to do those things for which we are responsible in the competitiveness equation.

Immediately following World War II (which, I am loathe to admit is now more than forty years ago), I joined Cutler-Hammer Inc. of Milwaukee, Wisconsin. At that time, the company recognized two distinct markets: the U.S. market and everything else ... the foreign market. (As an aside, I should note that, in Canada, our products were manufactured and sold by a company named Northern Electric.) As the years progressed, we became more sophisticated and redefined these markets as domestic and international. But we made conscious and distinct decisions concerning the allocation of resources and operating strategies between these two obviously different types of markets.

That situation is no longer valid, and it is a market discontinuity not fully recognized by many who are significantly impacted by it. There is no longer a Canadian or a U.S. domestic market. The size and homogeneity of the North American market have been recognized and targeted by almost all of the major producers of products and services throughout the world, to the benefit of the North American consumer. Canada and North America are now global markets. You can choose to serve them only, but that still makes you a global marketeer. You can't avoid global competition merely by staying within the boundaries of your home market. But, if by being in your home market you are already a global marketeer, and you are successful, why limit your marketing activities? Give some of your global

competitors a little something to think about in their home markets, rather than permitting them to concentrate all of their time and resources developing their Canadian or North American market positions.

I realize that, in the minds of many, this may appear to be an appealing but impractical concept, because the markets of many of the world's major trading nations are perceived, in varying degrees, to be closed to foreign-produced products. There is a degree of truth to this belief, but the real situation is not nearly as pervasive as most business people believe.

Unfair trading practices by other countries really influence only a small percentage of world trade flows. And let's not be so naive as to believe that our own markets are as free and open as we conveniently perceive them to be.

Few people recognize the major market positions held by numerous Canadian and North American companies in markets we rather casually write off as closed markets. Too often we confuse highly competitive markets with closed markets and, even more often, we fail to allocate sufficient market development resources to the penetration of new markets.

New market penetration is a process requiring patience, appropriate products, the acquisition of market intelligence and, quite frequently, the assimilation of new language skills. A one-week jet-aircraft visit to a new market that fails to produce an order does not constitute a closed market. It is rather a waste of corporate time and resources unless it is the initial phase of a sustained program of investment. Market development costs can be high and the time constant of the development process long. Therefore, targets for market penetration must be chosen with care, and development must be phased in a such a manner that each new success helps pay for the next investment.

In addition to thinking globally about market development, we must work towards a restructuring of labour-management relationships, with particular attention to increased cooperation between labour and management personnel in educating and in understanding and communicating the need for productivity improvement and cooperation in adapting to technological innovation and other forms of change. This includes an appropriate level of investment in human capital to equip the labour force with the education, skills and adaptability needed to meet the requirements of the coming decade.

Part of this responsibility lies with our public education system, which richly deserves the active support and cooperation of both parents and employers to succeed in its educational endeavours. I am proud of the leadership role that Northern Telecom has assumed in Canada on the issue of education. It is an issue that will have major consequences for our ability to recruit the skilled manpower that we will need to maintain and advance our technological lead globally. The initiative of a science and engineering scholarship program, announced yesterday by the Prime Minister, is certainly another important contribution to meeting this educational need.

"All competitors have access to good scientific knowledge and ... comparative advantage in new technology does not last long in today's world of virtually instant communication."

However, education and training do not cease upon graduation from the public educational system. Globally competitive companies are major investors in occupational skill training in their enlightened self-interest. I have a high level of confidence that the rapid growth of Northern Telecom in the past decade has been significantly aided by the ongoing training and education of our employees and those of our distributors and customers. In a typical year, Northern Telecom's multiple training schools provide in excess of 300,000 student-days of instruction.

It is quite common these days to hear it said that innovation is the key to national and global competitiveness. Unfortunately, this statement has somehow been distorted to imply that innovation is the exclusive prerogative of the so-called high-tech industries (such as those based on microelectronics, fibre optics, high-strength ceramics or genetic engineering). In truth, innovation is not linked exclusively to these high-tech fields; it is, in reality, the application of new knowledge to product, process or service in any field of endeavour. It is therefore equally applicable to the steel industry, the automotive

industry, the machine tool industry or the financial services business.

In fact, Canada is a good example of the universality of the application of innovation. A large portion of Canadian exports consists of food, fibre, minerals and energy — commodities that, in many cases, exist in abundant supply in other nations. Canada, however, has achieved a comparative economic advantage in the export of these products because it has applied innovation to the harvesting, mining, lifting, processing and transporting of them. To the uninitiated, some of these industries might appear to be low-tech, but Canada has achieved economic advantage in them by the innovative application of technology.

We all recognize that major changes are occurring rapidly in many, if not all, of our markets. In fact, change has been the one constant in our markets and will no doubt continue to be, probably at an accelerating rate. These changes cause what I call discontinuities and, as mentioned before, these discontinuities can be of a technological, regulatory or market structure nature. But each such discontinuity is a window of opportunity for the aggressive competitor, and innovation is the resource that can be used to develop maximum gain from each of these windows.

Most companies recognize the need for innovation to present new products, lower operating costs and improve quality. However, the current corporate buzzwords such as corporate streamlining, restructuring or productivity improvement do not in themselves necessarily produce growth. They are often forms of a defensive, rather than an offensive, strategy. Much of the restructuring or disposing of under-performing units is in response to the pressure of corporate raiders, while streamlining or downsizing is accomplished through outsourcing of high-cost manufacturing operations to meet the competitive threat of Pacific Rim or other competitors. Streamlining often involves the elimination of layers of management and a general tightening of costs throughout the organization.

The net result of all these activities, many of which are extremely painful, is in many cases only competitive survival rather than the creation of new comparative advantage. In my two tours of duty in the United States Marine Corps, I was told that defence was undertaken only for the purpose of awaiting a more favourable situation in which to attack. If streamlining, restructuring or downsizing have been our defence, is it now a more favourable time to attack? And, if so, what are the resources available to us to support and sustain a successful attack? Many of our global competitors have available to them resources not unlike ours, so it must be the method of deploying our resources that will determine success and the ability to sustain our offensive strategy.

All competent competitors have access to good scientific knowledge and, as mentioned before, comparative advantage in new technology does not last long in today's world of virtually instant communication. Achieving comparative advantage from a virtually common base of knowledge is therefore dependent upon the uniqueness of its application to a conspicuous customer solution and the speed with which this solution is delivered to the marketplace.

This is, in fact, the strategy that has been followed by Northern Telecom for the past 15 years. It is illogical to believe that Northern Telecom has consistently had access to a superior base of scientific knowledge than have our global competitors such as AT&T, Siemens or Nippon Electric. However, Northern Telecom was the first company to recognize the conspicuous customer solution represented by digital telephony and the first to place digital switching and transmission systems on the market. Identifying this conspicuous customer solution and making it available to our customers several years ahead of our major global competition was, in reality, the decision that made Northern Telecom what it is today. But Northern Telecom is only one example of the adage that maximum rewards from innovation come from creating enhanced customer values on a timely basis.

I sincerely believe that market needs and customer requirements have probably changed more, and will continue to do so, than most supplier organizations recognize. This discontinuity in perceived market demand provides the opportunity for the aggressive competitor, and it is in this fertile area that most of the successful marketeers have planted their now flourishing crops in the gardens of Canadian and North American markets.

How seriously or how recently has each of us performed a detailed analysis to ensure that we are not just selling what the plant produces rather than what the customer (especially tomorrow's customer) really wants to buy? Even if we are selling him the hardware he really wants to buy, are we also offering him the corollary services and support mechanisms that he needs to maximize the value of our products to him? And, most importantly, what is the difference in economic value in doing business with us, as contrasted with doing business with someone else? Unless the answer to this last question is significantly greater (such as an order of magnitude), we had best immediately revisit our inventory of conspicuous customer solutions to ensure that

incremental differences in value are restored to significant differences and soon. If we don't, someone else will.

Companies that innovate with environmental change are subject to changes themselves. In the electronic systems business, I believe that companies destined for long-term success will exhibit characteristics such as these:

- the hardware content of their sales dollar will continuously decrease;
- the R&D content of their sales dollar will continuously increase; and
- the sales, service and support content of their sales dollar will continuously increase.

In the very best of these companies, electronic hardware costs will be driven towards zero in order to provide the revenues to support additional R&D; additional sales, service and support costs; and at the same time accommodate continuously declining market prices. Zero hardware cost is obviously somewhat of an exaggeration but, in the electronics industry, it is not a bad goal. In other industries, zero hardware cost is not a reasonable goal, but a significantly reduced hardware cost is an absolute necessity, not only for expedited growth, but also for long-term economic survival.

Unfortunately, most successful long-term growth scenarios require front-end investments in people, R&D, new capital equipment and new market development. These investments are always difficult to accommodate in parallel with the incessant demand for constant improvement in quarterly financial performance. And therein lies the conundrum for today's business executive.

In many ways, this conflict of alternative business strategies is very similar to the television ad in which an automobile mechanic is peddling a new improved brand of motor oil and, holding up the can to the viewers, he says, "pay me now, or pay me later." The choice is not a simple one, and I well recognize the hazards for corporate executives that lurk in the murky shadows of today's overactive financial marketplaces. But in the final analysis, investment now emerges as the only economically viable solution. Improved current performance achieved through investment avoidance is just not a reasonable strategy. Long-term failure is virtually guaranteed and, in effect, all you are doing is playing with its date of occurrence.

Finally, I would like to deal with the time dimension of innovation. New scientific knowledge enjoys an ever-shrinking window of opportunity for successful exploitation because of the ever-increasing rapidity of its global dispersion. To extract from innovation its maximum rewards, you must not only produce a conspicuous customer solution, but you must also build an organization whose response time is capable of bringing this solution to the market in a manner that best serves your customers and pre-empts your competition.

"Improved current performance achieved through investment avoidance is just not a reasonable strategy."

Real economic advantage requires of management a uniquely active capability that is not easily achieved or matched by others. Consistently greater speed in making management decisions, developing new products and delivering hardware or software to customers ahead of competition creates that advantage. Fast-response companies are also likely to have lower costs and be more innovative than their competitors.

The Boston Consulting Group has recently coined a new business strategy that they have named: "Make decisions like a fighter pilot." This strategy is based on a United States Air Force study to determine why certain pilots consistently won dogfights in wartime. The findings confirmed that the winners completed the loop of observation, orientation, decision and action faster than the losers. From this study, the BCG

draws the following conclusions:

"The business world moves faster today. Business competition has become more like an encounter between fighter planes than a chess game, which has been our prevailing analogy. Product life cycles are much shorter, and new products that use hybrid technologies are more frequent. Mass markets are dissolving into smaller customer segments, making competition messy. New materials and technology are multiplying company choices in how to design, make and distribute a product.

Typically, less than 10 per cent of the total time devoted to any work in an organization is truly value-added. The rest is wasted because of unnecessary steps or unbalanced operations.

Fast-response companies not only have market advantages, but also tend to have lower costs because, when production materials and information move through a company's operation, they collect less overhead and do not accumulate as inventory. Also, a company can innovate more effectively, because more new products can be conceived and engineered in a given period, giving customers more choices."

I believe you will agree with me that the BCG's strategy of making decisions like a fighter pilot has a lot to recommend it and is deserving of careful thought in application to our own operations.

We've reviewed a wide range of topics in this discussion, most of which I hope you will have found to have positive application to competitiveness in today's fast-moving global market. To me, the inherent opportunities vastly outweigh the potential problems. But to successfully exploit these new opportunities, either as a nation, a business or individuals, we must continuously reaffirm our active commitments:

- to creating superior customer values;
- to taking a hard edge to our competitive efforts;
- recognizing time as a gating competitive advantage;
- to focusing on high-yield activities and profitable growth;
- to be global in our reach and thinking; and
- to go on the attack to provide conspicuous customer solutions.

RITA DIONNE-MARSOLAIS

VICE PRESIDENT, INFORMATION CANADIAN NUCLEAR ASSOCIATION

Mrs. Dionne-Marsolais was born in Sherbrooke, Quebec. She is an economics graduate (M.A.) of the Université de Montréal.

Prior to her appointment as Vice-President, Information of the CNA, she served as Quebec's Delegate-General in New York from 1984 to 1987. Mrs. Dionne-Marsolais is a member of several associations, including the Economic Club of New York, the Montreal Chamber of Commerce, the National Association of Business Economists and the Women's Economic Round-table.

INTRODUCTION TO WORKSHOP SESSION C

FOSTERING NEW TECHNOLOGY-INTENSIVE FIRMS

JANUARY 14, 1988

I am very pleased to be opening what is, in my view, the most interesting workshop. In this workshop, we can talk in concrete terms, and we will be talking about the future. It's easier, I think, to talk about preparing for the future. Now, having discussed how to revitalize existing industries, develop businesses for future markets and develop higher value-added activities, it is time to consider how to create new technology-intensive companies, which are in the end the basis for economic growth.

I had prepared notes but, with everything that's been said here over the past day-and-a-half, I would like to modify my introduction slightly, coming back a bit on what the Prime Minister said in his opening remarks.

He told us about very interesting programs in terms of concentrating our efforts on developing Canada's assets, whether these be research, know-how or human resources such as students. Now it is up to us, as active members of this society, to decide how we are going to take up the federal government's challenge. How do we visualize the link between industry, technology and universities? The time has come for us to demonstrate our commitment, and this is the purpose of the ten workshops being held this afternoon.

We must concentrate on the elements of our society, and that means all the elements: industry, business people, employees and their representatives, instructors, universities, government officials, and permanent representatives in permanent infrastructures like research centres. All these elements have a role to play in taking up the challenge of preparing our future. And they have a role to play in fostering the development of these new businesses. We are talking about technology, about technology-intensive companies, and I would like us to concentrate on the simplicity of technology, to familiarize ourselves with the very basic uses of technology. There were several discussions in the workshops I attended in which others commented on how at ease we are with technology. But, in actual fact, is everyone really comfortable with his kids' computer or with his own? With his wife's microwave or his own? Are these technological developments really all that simple to use? People

will have to feel fully at ease, feel they dominate the technology in their everyday activities, if we are to change and influence their perception of innovation.

"Now it is up to us, as active members of this society, to decide how we are going to take up the federal government's challenge."

Let me now say a word about innovation and technology. Innovation requires initiative; it is to some extent confirmed by initiative. So in both large and small businesses, to encourage initiative is to encourage innovation, which in turn — and here I am repeating what several speakers have said before me — stimulates the technological development of our companies and generates offspring, creating little companies out of an idea or the application of an idea. I was listening to one of our participants today saying: "The technology is there, but we still have to recognize the component capable of serving a specific purpose, and we need the necessary support to then start producing or marketing it." Therefore, the real challenge facing us this afternoon is to make clear and specific suggestions, being as clear and specific as the Prime Minister was in announcing his programs. He did not go into detail; he said: We are injecting so much money, we are creating a panel of international experts, and we are offering grants. In my view, these measures are very clear. As participants and elements of society, can we say the same? Are we ready to propose that we meet on a regular basis, that we improve information exchange on technology and business among the various elements of our societies?

The three topics which my discussion leaders will be covering today — we reached a near-consensus on these three essential points before lunch because everything revolves around them — relate to the elements or factors that give rise to initiative and entrepreneurship. In this regard, it is very interesting that — and here I wish to thank the conference organizers — a Quebecker was chosen to speak on this subject and report on these workshops. This is not because Quebec is particularly unique in this domain but because, over the past 25 years, the province has witnessed a phenomenon of aggressive economic development — aggressive in the positive sense of the word — owing to the initiatives taken by individuals who make up our society.

The second point we will examine — again in terms of an offensive strategy, to use Mr. Fitzgerald's expression — is the two elements of change in a society: business, hence human resources, and capital or financial resources. I think the Canadian financial community should be heard on this topic, and I will be listening closely, because I think they have a lot to tell us. When it comes to venture capital, if you want to call this venture capital, the Canadian financial community is very cautious. As all Canadian entrepreneurs from east to west see it, venture capital is much more accessible in the south than in either the east or the west, and it shouldn't be that way. This is the responsibility of the financial institutions, which, if you want my opinion, receive very good treatment and whose balance sheets indicate they are doing very well. Will their balance sheets be adversely affected if they concentrate some of their efforts on more dynamic areas? I don't think so. They have made bad investments abroad and it hasn't killed them. So if we look only at the percentage of funds that could be set aside for or directed to the development of our small technology-intensive businesses, I feel there is some thinking to be done, and I hope the workshop leaders will be able to get impressions, comments and, especially, commitments out of the financial community. I believe the university community also has interesting suggestions and possible commitments to make at this conference.

In closing — because it is much more important to

listen to you than to me — I would just like to remind you that we are looking for specific points, specific recommendations, because the opportunity we will be given tomorrow to report to the Prime Minister will not be given to us often. This is the first time, to my knowledge at least, that such a gathering, as impressive in quality as it is in number, has been given the opportunity to report, make commitments, comment and work together for the government to do, in effect, what society is compelling it to do. So it is up to us to deliver the goods, and I hope our discussions will be fruitful.

THE HONOURABLE

FRANK OBERLE

MINISTER OF STATE
(SCIENCE AND TECHNOLOGY)

ADDRESS

JANUARY 14, 1988

In preparation for my speech, I came across some interesting information which I feel compelled to pass on. If my facts are correct, no less than 2.8 tonnes — that's metric tonnes — of paper have gone into making this conference the success it is. Being from the pulp-producing area of northern British Columbia, my constituents and I would like to say a heart-felt thank you.

Also, I want you to know that as an active participant at this prestigious conference, I've also been counting speeches. This is the sixth speech that you've heard and, bearing that in mind, I have decided mine should be as brief as possible.

While I will try to be brief, in many ways, I think the message that I have to give is critically important, because it deals with public awareness and the concept of a science culture, which I see as perhaps the most important prerequisites to meaningful progress and change.

Yesterday, we heard the Prime Minister highlight the challenges facing this nation and how each of us in government, the private sector and learning institutions must work together to keep Canada competitive.

We also heard from my colleague, the Honourable Robert de Cotret, about how we, in the federal government, plan to reorganize ourselves to respond better to the challenges that you're throwing at us and that the changing world is throwing at us.

In the next few minutes, I would like to address these same issues from a slightly different perspective.

I'm sure it comes as no surprise to most of us here that Canadians generally do not yet fully appreciate the significance of the fundamental shift we are experiencing from a resource-based economy to a knowledge-intensive economy. Yet I notice a growing awareness among the opinion leaders of this country. Your attendance at this conference is an indication of this growing awareness.

One of the overriding challenges, therefore, must be to ensure that each Canadian comes to share our awareness that science and technology are the keys to meeting the challenges of international competition and to adapting to the changes that are thrust upon us by this competition. Without the support and understanding of all Canadians,

the door to a prosperous future will remain locked.

This is why one of the principal elements of both the National Science and Technology Policy, which my provincial and territorial colleagues and I signed in March of last year, and InnovAction, the Canadian S&T Strategy which followed it, is the concept of a science culture. Essentially, it is the need for public awareness and understanding of the crucial role science and technology must and will play in Canada's future.

We must ensure that every school child is provided the opportunity to study science and math and is encouraged to do so to prepare them for their futures in a new age. In that, they need guidance. They need encouragement from their parents and their teachers.

Yesterday, the Prime Minister indicated our government's commitment to addressing this situation in part by announcing the establishment of the new Canada Scholarships program for undergraduates in science and technology. This measure will provide opportunities to young people who have chosen careers in science.

All of us here would agree that it is essential that we have a strong supply of qualified men and women to meet the demand that will be created by industry, which will increasingly depend upon technology to survive.

Only a few months ago, my department conducted a survey on public attitudes about science and technology. This survey produced some very startling and worrisome information. For instance:

- A majority of Canadians do not see the link between technology and improved economic performance.
- Parents in households earning over $40,000 a year are below the national average in thinking a career in science would be good for their children.
- Too many Canadians still see technology as a threat to job security.
- Canadians do not associate a better quality of life with S&T.

These attitudes are already reflected in the composition of our labour force, where industry is already suffering shortages of highly-qualified personnel in computer science, mathematics, biotechnology and other advanced skills.

Those are tough biases to overcome. Change will not happen overnight. But we must change if we want to become more competitive and more advanced in foreign markets.

The Prime Minister's advisory council addressed special attention to the problems of young women who are still missing out on future-oriented careers, largely due to long-held prejudices about women's role in society. I am pleased to observe that there are a growing number of exceptions to this phenomenon. But we found that, at the university level, where women comprise half of the student population, they only account for 12 per cent of the engineering and natural sciences scholars earning bachelor's degrees.

"Technologies wisely adapted to the needs of our traditional industries will make them even more efficient."

As I said earlier, to a large extent, this results from parents and educators failing to encourage young women to study math and sciences throughout their school years. Thus, in these enlightened, liberated times, women still find their career options limited.

We must change our attitudes, because they hurt industry and society; they hurt our chances to supply the highly qualified people this country needs. Public attitudes must change, because our future depends on it.

The importance of public awareness goes beyond the education of our youth. It is not sufficient to create a supply of well-educated and technologically literate students. There must also be a demand, a demand that is created by industry. That's where you come in. We have all just participated in a day-and-a-half of discussions about what the private sector must do to strengthen the Canadian economy.

With the heightened awareness created by this conference, we hope that business will not only better appreciate the need for applying technology, but also will go further and create a demand for these highly qualified people. In fact, as we learned at noon today, the best companies are playing an important role in training. I notice some welcome changes in corporate attitudes. Business in this country is beginning to focus greater resources on research and development.

However, in order to stay among the leading nations of the world, science and technology must become important elements of the very soul and the very culture of our nation. What we are talking about is strengthening those cultural characteristics which can nourish the inquisitive

minds and the intellectual genius of our people. Science and technology must become part of every Canadian's daily experience. Like fine arts, literature, music and sports, they must be part of our national identity as they are for people in other countries with whom we must compete.

In the past, we have been able to rely on the riches of the land — our natural resources. We have heard that theme repeated again and again. These riches will help us to make the transition. They ought to be celebrated. But the currency in the new age is intellectual capital — knowledge and information. Our wood, water and minerals no longer command the same value on world markets.

But technology will help our resource sector to remain competitive, to sharpen its competitive edge. Technologies wisely adapted to the needs of our traditional industries will make them even more efficient. New technologies will help us become better custodians of our renewable resources and enhance the value of products.

Even so, as you would all agree, we have to lessen our dependence on our traditional industries.

I am glad to see the media so well represented at the conference. They have an important role in changing Canada's national mind set. The media acts as the eyes, ears and often the voice of the people in a vibrant, functioning democracy. They have a significant responsibility to prepare society for social change — change in which technology has and will continue to have a profound influence. The media, therefore, can also play an important role in providing the necessary information to hasten a broad public understanding of the role of science and technology in our society. Over the past few years, the media has been increasingly observant about the impact of technology on each of us.

You know, history has shown that whenever Canadians reach a consensus on a national goal and put their energies to work, they not only succeed but also excel. When Canadians embraced it as a national goal to overcome distance and geography, which may have been obstacles to developing a sense of nationhood, they harnessed technology to turn adversity into opportunity.

For example, at the turn of the century, we surprised the world by tying our great nation together with the transcontinental railway. In more recent times, to meet the same national objective of improving communications among our people, we developed sophisticated telecommunications networks and systems, which, as we discussed, did not only satisfy our own needs but also found acceptance in markets all around the world.

These accomplishments, stretching from the early days of Confederation, are truly a cause for celebration. That too is important as part of an awareness campaign — to celebrate our achievements. It's important for every citizen to know that Canadians have been among the best in the world in research, development and the use of technology in building a nation that is envied around the world.

I think all of us here see the need for greater public awareness about science and technology. Certainly the government does.

Therefore, I am pleased to announce an initial two-year phase of a major national campaign to increase the public's awareness of science and technology. This campaign will reach into every home, every boardroom, every union hall, every playschool and every classroom in the nation. It will involve information, education and participatory programs, perhaps somewhat along the lines of the very successful Participaction program for fitness and health.

The first phase will deal with that kind of an awareness campaign. However, it will become something much more comprehensive as we move into educating and re-educating teachers and developing a national curriculum.

There is no issue of public policy where it is more essential that the federal, provincial and territorial governments cooperate to achieve a common goal. I am assured of the cooperation of my colleagues on the National Council of Science and Technology Ministers.

Improving public awareness about science and technology is not a partisan issue, nor is it one that you can leave exclusively in the hands of politicians. This is a national undertaking to which all of us — government, business, labour and educators — must commit ourselves.

The Prime Minister has invited all of you here because you have the power and the influence to make decisions and lead opinion. He has asked for your help. My provincial and territorial colleagues and I are asking for your help. I am asking for your commitment to assist us in this important undertaking.

In closing, let me again thank you for the effort and personal sacrifice you made to come here and for being so patient in listening to our lectures and pleas.

Let's stay in touch.

DR. JOHN R. EVANS

CHAIRMAN &
CHIEF EXECUTIVE OFFICER
ALLELIX INC.

Dr. Evans has been Chairman and Chief Executive Officer of Allelix Inc. since 1983. Allelix is a Canadian biotechnology research and development company active in the fields of health and agriculture. He serves as Chairman of the Board of Trustees of the Rockefeller Foundation, as Director and Chairman of the African Medical Research Foundation (AMREF Canada) and as a Director of Alcan Aluminium, Dofasco Inc., the C.D. Howe Institute, the Royal Bank of Canada, Southam Inc., Torstar Corporation and Trimark Financial Corporation.

SURVIVAL IN A TECHNOLOGICAL WORLD —

FROM ADVERSARIAL TALK TO COLLABORATIVE ACTION

KEYNOTE ADDRESS

JANUARY 15, 1988

For more than 20 years, efforts have been made to enhance the recognition in Canada that research and development is critical to the country's economic future. These efforts really seem to have had very modest effect on the actions of all sectors in this country. Numerous reports, studies and meetings, along with governmental and non-governmental organizations, have directed attention to these fundamental issues. But awareness is still confined primarily to those directly concerned with R&D. Let's not forget that, as recently as a few years ago, science and technology seemed to have been a blind spot in the studies that were undertaken by the MacDonald Commission.

In the past two years, awareness has broadened: many economists, particularly in the United States, now believe that the largest single factor behind growth and productivity is innovation, to which they attribute as much as 80 per cent of growth in the last half century. The Nobel prize in economics was awarded last year to Robert Solow of M.I.T. for his work establishing that technology is at least as important as capital, labour and resources in determining the level of economic growth and development in a country. And Judith Maxwell and her colleagues have done Canada a very important service by stressing similar conclusions in the recent report of the Economic Council of Canada.

This awareness is long overdue but, as David Culver noted from Alcan's experience, it is still a giant step to move from talk to action, to bring science and technology from the periphery to the centre of corporate decision-making. This will involve major changes in attitude and in the way of doing business not only in industry but also in labour, education and government. Our competitors among the industrialized countries are well along in the change process and, in any comparison of indicators of science and technology performance, Canada lags badly.

In order not to slip further behind and, more importantly, to begin closing the gap in performance, Canadians must be un-Canadian in

two important respects: first, they must act, not just talk, and they must act boldly. Second, the actors must work in concert. With limited resources, industry needs the full collaboration of government, labour and universities in order to make significant progress. The challenges are formidable, and no country can afford to dissipate precious science and technology resources in unproductive competition. Japan, Sweden and even the United States have recognized this.

The science and technology record of Canadian corporations overall is dismal. Only 2 per cent invest in R&D and, of these, less than 7 per cent account for nearly two-thirds of all the R&D performed. Alcan, Northern Telecom and a few others serve as impressive models for the central role technology must play in the long-term agenda of corporate development. But 98 per cent of Canadian companies have little appreciation of the potential of technology for improving the competitiveness of their products, processes and services, and very few of them even have scientists or engineers on staff.

Rectifying the situation will require changes in corporate organization that place technology and management at the center of business decisions. As Dr. Stuart Smith wrote last year: "It is only as a result of these changes that increased long-term commitment to R&D will ensue." I will now echo a major theme which has cut across discussions at this conference. I would just like to emphasize that what is involved is a far-reaching change in attitude about the value of science and technology, not as new hardware, but as new ways of doing things. It also involves a change in attitude about the basic objective of R&D — not how to manage it more effectively to create knowledge, but how to transform new knowledge to create wealth.

Because the change in attitude in industry is so fundamental, it is worthwhile to pick out some critical elements:

1. Science and technology should be mainstream, not backroom, in corporate decision-making. Innovative technology is a strategic resource and must be integrated with capital, labour and resources in strategic planning.

2. Expenditures on science and technology are investments, not handouts or donations, and like other investments, they need to be planned, targeted, managed and evaluated. They are long term and will be undermined if they are turned off and on with cyclical earnings.

3. Planning and management of science and technology to improve wealth generation requires in-house technical competence, whether the firm is making or buying R&D. This must be complemented by technical awareness at executive, product development and marketing levels.

"...many economists, particularly in the U.S., now believe that the largest single factor behind growth is innovation."

4. Internal self-sufficiency in science and technology capability is now beyond the resources of even the largest R&D-intensive corporations. Corporations need to be more outward-looking and interdependent. First, they must broaden their horizon for scanning for relevant technological innovation by contact with cutting-edge science and technology in different disciplines in universities, government laboratories and small high-tech firms. Second, they must collaborate with other industries to mount critical-mass R&D efforts in complex areas.

5. Retraining the work force is a critical investment in generating the wealth made possible by technological innovation. This has been demonstrated by case studies in the computer industry. But skills development is often neglected by Canadian industry. For example, in computer-related industries, Canadian workers get about two hours of in-plant training annually compared to 100 to 200 hours for their Japanese counterparts.

None of these ideas are new to industry. The challenge, however, is to translate them into action and, again, as we've heard, this is not an easy task. Repeated conferences and exhortations have not had a dramatic effect. These efforts should be continued, but something more is needed.

First, industries not engaged in science and technology should be encouraged to develop technological awareness and competence through exchange programs with universities and government laboratories and through assistance with the incremental costs of initial employment of scientists and engineers.

Second, industries with R&D activity should be encouraged to invest some of their R&D activity externally in university and government research groups to broaden technological horizons and to establish new and relevant working relationships.

Third, Canadian firms need stimulation to enter into strategic alliances for joint product and technology development and R&D consortia including several industries and university research groups. Shared support programs of pre-competitive collaborative research are now prevalent in Europe, the United Kingdom, Japan and the United States. In Canada, one good example of this approach is the collaborative initiatives, supported by the Premier's Technology Council in Ontario, which network R&D efforts undertaken within corporations, industry and government labs as part of a coherent program of collaboration. It is important to emphasize that industry must play a lead role in the planning and execution of the collaboration if the R&D is to be captured and commercialized.

Finally, incentives should be offered to industry, universities and technical colleges to expand greatly specialized course work and on-the-job retraining to help workers cope with technological change. Regrettably, most incentives to date have had their greatest impact in the industries already active in R&D. It is reminiscent of the scene in the movie *Casablanca* where the police inspector, in response to an incident, says to his lieutenant: "Round up the usual collection of suspects." As noted previously, only 2 per cent of Canadian companies do R&D, and two-thirds of the R&D is carried out by less than 7 per cent of that group. The challenge is to reach the remainder, the 98 per cent, to help them develop the technological capability to meet their needs.

If Robert Solow's thesis on the importance of technology to economic productivity is as true for corporations as it is for the country, one approach to draw in more of the 98 per cent would be an R&D levy of about 1 to 2 per cent of pretax profits on all corporations, with an appropriate floor to exclude corner-store operations. Those corporations performing R&D above this level would have their contributions refunded; the remainder would contribute automatically to the national support of R&D. Coupled with direct incentive programs to assist these corporations to build R&D capacity (e.g., subsidies to hire scientists and engineers as in West Germany and Sweden and the Industrial Research Assistance Program for technology transfer), the levy might prove successful in expanding the proportion of Canadian corporations actively engaged in technological innovation. I recognize that tax levies for a specific purpose have, in principle, been taboo with finance departments since the Napoleonic era. Nevertheless, if we are talking about fundamental attitudinal changes, why should finance departments be exempted?

Universities are another area where attitudinal changes are crucial. The quality and accessibility of university research is increasingly recognized by industry as a critical factor in technological innovation. The complexity of the underlying sciences and the speed with which they change have rendered obsolete the traditional separation of basic university research and industrial application. There has been reluctance, however, on the part of Canadian universities, with a few notable exceptions, to accept as a prime mission enhancing national economic development directly through their R&D efforts. Canadian universities have tended to view relations with industry with suspicion. The potential threat to academic independence seems to have outweighed the potential benefits for faculty and students of planned interdependence. Yet realization of these benefits is well illustrated by an institution such as M.I.T., which certainly has not sacrificed scholarly achievements in order to achieve impressive technological transfer, to establish new businesses and to enhance existing businesses. The M.I.T. record of Nobel prizes during this period exceeds what has been done by countries such as Japan and Canada together. There has been no sacrifice of that real scholarly development while this technology transfer process has been taking place.

"Like industry, government must look at R&D expenditures as investments, not handouts."

The first challenge for Canadian universities is, again, an attitudinal change — to accept the

positive value of contributing through research to Canada's economic development; to encourage spin-off high-tech ventures by faculty; to encourage the industrial application of university research; and to recognize fully work by university professors with industry in evaluating their career advancement. The Corporate-Higher Education Forum has been a particularly valuable vehicle for building mutual respect for the distinctive goals of universities and business and, at the same time, establishing a basis of trust for closer collaboration. There is now much more commitment at the top of universities in Canada to collaboration with industry. The difficulty in these organizations is spreading this spirit down through the institution.

The second challenge is to bring university programs in economics, commerce and management into the technological era. Few academic programs in economics have adopted Nobel laureate Solow's conclusions, and even fewer business schools have integrated management of technology into their curriculum in the way that it has been done by the International Management Institute in Geneva and the Sloan School at M.I.T. This will not be achieved by an occasional lecture in technology management in a school of business or engineering or by sending out some of the students to study a high-tech firm as a single case study. The national granting councils in Canada should offer career development awards to strengthen academic and industrial capability in the management and marketing of technological innovation. Furthermore, technically literate industrial leaders, government economists — especially in the Department of Finance — and economically literate engineers and scientists are essential to future industrial development in Canada.

The third challenge to universities fits precisely within their traditional mission to pursue world-class excellence in research. Regrettably, this aspect of universities in Canada has been short-changed by provincial policy for funding higher education, which has given priority to undergraduate access to universities, and by federal research granting policies, which have been overly sensitive to geopolitical equity. Educational accessibility and regional development remain important policy objectives but, with limited resources, one of the casualties has been centres of research excellence.

A country of 25 million people cannot possibly support a world-class level of advanced research in all areas in every region. Universities and governments must promote differentiation of institutions with a concentration of resources in some areas in order to create one or two centres or networks in specific fields of research which provide the breadth and depth of personnel and resources to carry out truly excellent research and research training. Dr. Fraser Mustard's Canadian Institute for Advanced Research exemplifies the network approach to this problem. Centres of excellence should help to retain our best scientists and offer attractive career prospects in Canada to our most able research students. At the same time, they should create the world-class research groups so important to industrial innovation.

The Prime Minister's announcement on centres of excellence is extremely encouraging, and it may seem ingracious to offer words of caution, but I do so anyway. First, let us not allow regional or institutional politics to make a caricature of how they are developed. Second, industry must be a full partner from the outset, if we are to realize the full economic impact of this investment.

The financing of basic research in Canadian universities remains a matter of great concern. First, the level of direct support has not kept pace. And second, the indirect costs of scientific research have placed an increasingly heavy burden on the general operating revenues of universities, particularly those institutions with the highest quality research. The Science Council and others have recommended increasing research grants to cover the estimated 65 per cent indirect costs associated with research, the so-called full-cost support of university research. I strongly support this direction but, in order to ensure that the policy encourages excellence in the quality of research and that the funds are not diverted to general institutional needs, I suggest that for an initial period of, say, three years, the 65 per cent allowance for indirect costs be limited to the top tier of university research projects, for example, the NSERC strategic grants and the top one-third of operating grants from the granting council competitions. I would like to re-emphasize that the purpose of this policy would be to provide a strong incentive and reward system for universities to aim for developing world-class research groups which would compete for and win top-tier, full-cost research support.

At the same time, universities should adjust internal processes to optimize their research capability. Policies such as release time for research-skilled faculty, coordination of research support services and priorities for use of university-controlled research funds need to be addressed, as has been outlined in "The Changing External Environment for Research," the excellent discussion paper prepared by vice-principal Duncan Sinclair of Queen's University.

Research support policies of the granting agencies and the universities should give special attention

to talented young investigators who will be the future research leaders. The scholarship fund announced by the Prime Minister will be an incentive for undergraduates to pursue a scientific career. In addition, some of our science and engineering graduates need to be able to get experience in their field in a way which is more directly related to future employment in industry. Postdoctoral fellowships should be available to fund a one- to two-year working visit to the best institute or laboratory anywhere in the world followed by a two-year, 75 per cent contribution to salary in a Canadian company. In this way, a continuous track would be provided from top-quality research training to industrial employment. It would also help to ensure that future scientific leaders in industry have strong international research connections.

While the primary responsibility for execution of science and technology rests with industry and the universities, governments play an extremely important role in stimulating and supporting the efforts in both sectors. I have selected three areas of government involvement for specific mention.

"With limited resources, industry needs the full collaboration of government, labour and universities in order to make significant progress."

First, there is the need for adequate government investment to support directly each stage of the innovation cycle: basic research and research training; technology transfer from university and government research laboratories; precompetitive, collaborative research programs involving industries and basic research groups; and product launch assistance of the type available in Sweden and Japan, which is so important to small companies for financing the pilot or demonstration phase and market entry of a new product or process. Direct government support is particularly important for the success of high-risk and long-term science and technology projects. It is also vitally important to high-technology start-up companies in countries like Canada with very small domestic markets.

Second, governments in Canada should use their domestic procurement power more effectively to help establish infant industries and to launch new products and processes. Furthermore, making Canadian firms prime contractors will strengthen their systems integration capability and their ability to compete in international markets. The capacity of Canadian companies to innovate could also be greatly strengthened by contracting out more research and development rather than doing it in government laboratories. Canadian industries need the civilian equivalent of the massive defence contracts for R&D which firms in other countries enjoy.

Third, if industry is going to lead the innovation process, the most important incentives will be indirect through the tax system. On the whole, Canada's tax system is supportive to industrially-driven R&D. However, the current proposal to cap R&D tax credits at a percentage of federal tax payable will hurt the companies which make the largest R&D investment and will be particularly damaging to start-up companies with cyclical earnings. The elimination of R&D limited partnerships will aggravate the problem of financing high-technology start-up companies not yet earning significant revenues. Also, there is still a real problem in the interpretation by Revenue Canada of eligible R&D, which causes both uncertainty about rules and delays in rebates. As well, at the provincial level, surely it is counter-productive to tax federal investment tax credits. I cannot emphasize strongly enough that tax policies affecting R&D should be truly consistent with the stated overall policy of government to enhance Canada's industrial competitiveness.

In conclusion, Mr. Chairman, it is encouraging that federal and provincial governments are moving science and technology from the wings to centre stage when considering economic policy. It is particularly encouraging that First Ministers are making science and technology part of their personal leadership agenda. The convening of this conference is a reflection of the vision and leadership of the Prime Minister and that of Ministers Oberle and de Cotret. Commitment and credibility require, however, that investment by government to support science and technology keep pace and that the climate-setting instruments of tax policy, procurement and intellectual property rights match the stated intent of encouraging R&D investment by industry. Like industry, governments must look at R&D expenditures as investments, not handouts. And like industries, federal government departments and agencies and the two levels of government need to operate in a complementary and collaborative mode — not competing with and undermining one another. The establishment of the National Advisory Board on Science and Technology, NABST, is an encouraging sign. It is also encouraging to see the

federal and provincial ministers of science and technology sharing in the development and articulation of these policies.

I was watching television on Sunday night while trying to write this speech. My wife asked me to come and watch the national news. Prime Minister Mulroney was on the news, noting that Canada was the only country in the industrialized world that had gone backwards in recent years in terms of R&D expenditure in relation to the GNP. This was a statement he made a few years ago. Drastic changes are required to reverse the situation, beginning with fundamental changes in the attitude of the principal actors: industry, labour, universities and government. The creation of a new Department of Industry, Science and Technology offers such an opportunity in government, but it is critical that it not be just old wine in a new bottle. We enter 1988 with confidence, *indeed real optimism, that* government is now ready to move from promising talk and reorganization of ministries to substantive action. We are also confident that principal actors have rejected divisive criticism and competition in favour of a collaboration structured to mobilize their complementary strengths. With such an approach, Canadian industry can be a strong player in a very tough economic contest.

REVITALIZING ESTABLISHED INDUSTRIES

WORKSHOP SESSION A SUMMARY REPORT

WORKSHOP DIRECTOR: DR. NORMAN KEEVIL

JANUARY 15, 1988

INTRODUCTION

This is a call to action from 200 of Canada's leading citizens. The participants in the workshop on Revitalizing Etablished Industries have two messages for you.

A. Revitalizing traditional industries through the application of technology is essential to maintaining Canadian competitiveness, jobs and our standard of living. This process will not happen or happen quickly enough unless we create a science and technology culture in Canada and develop technologically literate corporate leaders.

B. Competing in the world marketplace, established industries will need to play a major role. Innovative high-tech companies are being covered in workshop C; they fall into quite a different category. A number of established industries, through continuous revitalization, have succeeded in maintaining their competitive position in the world; others have not. Some older industries succeed; others may die. Governments should not support these, although fading industries and affected communities will need adjustment assistance.

I will now cover the consensus reached by the workshop participants.

CREATING A SCIENCE AND TECHNOLOGY CULTURE

Although technology is a powerful tool, generating high-quality jobs, wealth and high living standards, Canadians as a whole appear to lack an understanding or even an awareness of this.

The dominant theme in all of the workshop discussions was the importance of education, training and the development of Canada's human potential. Developing an awareness of science and technology should begin in the early school years, even for students beginning school at age five. Pivotal to improving the quality and standards in education is a better public perception of the value of our teachers.

Specifically:

- Teacher training must be upgraded, and more emphasis has to be placed on science and technology.

- A major science and technology public awareness campaign should be undertaken, patterned after the successful Participaction program. We, as citizens, have to heighten the awareness of our public opinion leaders, including our MPs and MLAs.

- Our individual and corporate success stories must be publicized to create interest and to generate excitement about scientific and technological innovation.

- Some of the Canada Scholarships should go to future teachers of science and technology.

- There should be more industry/academic interchanges. Industry leaders should visit schools. Textbooks should portray successful technology entrepreneurs as role models.

- One or two major science and technology projects of national importance should be undertaken to catalyze public interest in science and technology.

- Innovation should not be financed by debt. It would be a good idea to involve more citizens in Canadian ventures through equity instruments such as the Quebec Stock Savings Plan.

ESTABLISHING CORPORATE LEADERSHIP

The 1960s was a decade of manufacturing, the '70s a decade of marketing. The '80s and '90s demand new corporate leadership that is capable of managing innovation and technology. Unfortunately, much of Canadian management is

technologically illiterate, tending to use the management tools of the past.

Often, firms do not need to develop new technologies; they only have to become aware of existing technologies, which simply have to be adapted to meet their needs and to make them more efficient and more productive.

Technology should be seen as an investment and not as a cost. There are many entrepreneurial industries that are alert to taking advantage of opportunities and taking risks. We have to be prepared to take more risks to keep from becoming stagnant.

Some specific recommendations are:

- Business networks are needed to foster exchanges of information on technology.

- Innovation, human-resource development and long-term technology forecasting must be interwoven in corporate strategy.

- Technological champions at the executive levels are key to corporate success.

- It is important to have business and labour work together to manage technological change. This requires early consultations, cooperative implementation and retraining.

- One of our centres of excellence should encourage the effective management of technology and innovation.

- Company fellowship programs should be established to reward entrepreneurs and innovators.

- Large companies should act as locomotives to foster the technological development of their Canadian suppliers.

- Since innovation can occur only if both buyers and sellers are technologically competent, government should reintroduce a wage subsidy to encourage small and medium-size businesses to hire engineers who are familiar with modern technology. The NRC's Industrial Research Assistance Program (IRAP) could be further enhanced to this end.

PROMOTING BASIC RESEARCH AND PRECOMPETITIVE COOPERATION

The role of the universities is to develop people and ideas — not technology. Basic research is important but should be tied more closely to long-term industrial needs. Technology development itself should be led by industry. Specifically, the recommendations are:

- Universities must create an incentive structure to encourage professors to undertake relevant research in order to attract and motivate our best students. This will keep them in Canada, making them available for jobs in Canada.

- Government laboratories doing research for industry, when industry cannot do it for itself, should concentrate on precompetitive research and develop plans for commercialization with industry.

- Companies, especially small and medium-size ones, should cooperate in sectoral precompetitive research consortia.

The Prime Minister attending a workshop

CREATING THE ENVIRONMENT FOR INNOVATION

Governments face difficult choices in reconciling trade-offs between competitiveness and equity. Too often they favour the latter. This results in conflicting messages, lack of consistency and an unstable business environment. The recent tax reform changes are a good example. They tend to stifle rather than encourage R&D.

Although the discussion in our workshop focused primarily on how industry can help itself, a number of specific recommendations were directed to government:

- Government procurement and contracting out of research can be critical ingredients in the introduction of new technologies.

- There should be a single access point in government to provide information for small and medium-size businesses.

- Depreciation rates for tax purposes are based on unrealistic rates of obsolescence. In these days

of changing and emerging technology, existing equipment can become obsolete in two or three years. Under these circumstances, it is difficult to convince a board of directors to finance new equipment.

IN SUMMARY – A CALL TO ACTION

Mr. Prime Minister, our workshop concluded that fundamental changes must occur in the attitude of Canadians towards science and technology. We must develop a culture and society excited by science, innovation and technology. As David Culver said, the street phrase "what's new?" should take on real meaning and real significance.

Our corporate leaders must become more technologically literate. They are the vanguard of innovation. Universities have a role to play in providing highly qualified people and new ideas, but only business can turn these into new products, new processes and more jobs. Governments should concentrate on providing the basic infrastructure and supporting the innovation process. Working together, we can build the Canada of the 21st century.

DEVELOPING HIGHER VALUE-ADDED PRODUCTS AND SERVICES FOR THE MARKETS OF THE FUTURE

WORKSHOP SESSION B SUMMARY REPORT

WORKSHOP DIRECTOR: DAVID HENNIGAR

JANUARY 15, 1988

OPENING STATEMENT

The participants in the workshop on developing higher value-added products and services addressed a broad range of themes, issues and concerns. However, before proceeding to our specific conclusions and recommendations, I would like to make a general statement which, I believe, reflects a broad consensus which emerged from our discussions.

The participants in our round-table discussions clearly recognize the importance of technology and innovation to Canada. We agree with David Culver's assessment. This is not just a platitude. It is a deadly serious matter to our continuing economic and cultural prosperity. The status quo is not acceptable. To do nothing is to do wrong.

A critical and immediate challenge which confronts us, as a nation, is that this recognition is not widespread among Canadians. Many are nervous about technological change and lack confidence in our ability to meet its challenge.

We, the participants in this conference, know that this attitude is not well-founded. Addressing it should be a first priority for all of us. We were happy to hear Minister Oberle's announcement last evening of a national campaign responding to our concern.

We therefore commend you, Prime Minister, for the foresight and leadership you have demonstrated in bringing us together for this event. This conference has been a unique opportunity for a large number of the nation's academic, business, labour and government leaders to address these issues.

We share your hope that the conference marks a significant step forward in increasing awareness among all Canadians. In time, this will lead to a more vigorous Canadian innovation and technology culture.

The main observations and recommendations of the workshop participants are organized under the following headings:

- Value-Added Products, Processes and Services;
- Management Leadership;
- Labour Participation;
- Capital Financing;
- Education and Training;
- Role of Government;
- Building on Strengths; and
- Centres of Excellence.

VALUE-ADDED PRODUCTS, PROCESSES AND SERVICES

Developing value-added products, processes and services needs to be approached from a global, market-driven perspective. Obviously, the recently completed trade agreement with the United States will expand Canadian markets and heighten our ability to compete on a world scale.

Adding value will sometimes involve developing new technologies but, for Canadian business, it will more frequently mean acquiring and applying the best existing technologies.

This will require increased efforts to maintain up-to-date information about technology developments in other countries and to make whatever arrangements are required (joint ventures, licensing, consortia) to acquire technology to upgrade Canadian products. Companies will acquire the in-house capacity to keep abreast of, evaluate and apply these technologies.

International product and market knowledge must also be available and constantly updated to assist businesses, especially small and medium-

size businesses, to identify potential market niches.

The Export Development Corporation's Canadian content rules should be maintained as one way of encouraging larger, more experienced exporters to sponsor smaller, less experienced entrants into the export marketplace.

Patent information should be made more widely and easily accessible to potential users.

Companies should also seek ways to add value through improved design, service, packaging, quality and reliability of their products. This will not always result in opting for the least-cost product or process. Increasingly, value-added and product differentiation will be achieved by adding knowledge to a product or service (computer software is an example) to improve its performance and value to the customer.

Success in developing value-added products and services should, in all cases, be pursued with the customer's needs and expectations as a primary consideration. This will require engineering and sales personnel working closely with existing clients at earlier stages of design and engineering. The goal is to produce innovations that will add value to the products of both the industry involved and its clients.

MANAGEMENT LEADERSHIP

To ensure commitment, corporate executives must learn to understand the benefits of innovation.

Corporate leaders must provide vigorous, sustained leadership to acquire and apply the best new technology. They must become more outward-looking to seek out new markets on a global basis. Their companies must produce innovative, world-class, competitive, value-added Canadian products and services.

Introduction of new processes, materials and products will usually involve higher costs and risks, which management will need to recognize.

Canadians will have to stop avoiding risk and learn to manage it. There should be appropriate incentives for risk-taking and recognition that there will be some failures along the road to success.

LABOUR PARTICIPATION

Labour has a vital role to play in adding value to Canadian products and maintaining and improving our international competitive position.

There are good examples of companies where management/labour relations are supportive of production process upgrading. However, Canadian industry will need to continue developing innovative approaches such as employee skills updating and retraining strategies, recognizing that labour must be a full participant in the process of technological change.

New products and processes frequently involve a better educated, more highly skilled work force as well as changed management structures. The result is that management and labour have to cooperate closely in developing more flexible relationships.

Conference participants at a plenary session

CAPITAL FINANCING

In order to encourage technological innovation by Canadian firms, we need to examine ways of increasing the availability of risk capital, particularly for technological entrepreneurs. This could include relaxing the constraints placed by government on pension fund investments.

Canada needs more patient investment capital. Too often, investment decisions are based on short-term profit considerations, thus discouraging management based on longer-term innovative strategies.

Tax incentives have a powerful impact on firms' ability to finance innovation and to apply technology. The tax system must be changed to encourage risk-taking.

We feel that improvements are needed in the implementation and administration of existing R&D tax measures, for example, in respect of advance rulings. Also, the definition of what qualifies as R&D needs review, particularly in regard to imported technology and the development of extensions to existing products.

While the SRTC program may have been poorly

designed, leaving it open to abuse, we believe that the concept was sound and warrants reconsideration.

We ask you not to disregard the possibility of enhancing the tax incentive system for R&D. Incidentally, you will be interested to know that John Evans received spontaneous applause from this conference this morning for raising this point.

This area is not exclusively a federal responsibility. Some provincial governments have introduced innovative tax measures to encourage entrepreneurial activity, including R&D. Other provinces should consider similar approaches.

EDUCATION AND TRAINING

We must ensure that Canada's education and training systems are positioned to produce the most important value-added product — the qualified researchers, technicians and business managers who will lead us into the 21st century.

The teaching profession should examine its teaching methods in the light of currently available technologies. We should use technology to teach more effectively. This applies at all levels — primary, secondary and post-secondary.

We should seek to produce more well-rounded graduates. Science and engineering students should be taught essential business skills; business students should receive basic training in key technical areas; and both should learn more about the global marketplace and develop higher proficiency in foreign languages. The performance in this respect of post-secondary institutions in Quebec might well serve as an example to the rest of the country.

ROLE OF GOVERNMENT

The role of government in promoting value-added products should be to create a positive environment for progress in science and industry through establishing and communicating national priorities and through maintaining appropriate framework policies — fiscal, trade and regulatory, among others.

For example, the government might review:

- the fact that there is still no protection for computer software under current copyright laws;
- the regulatory barriers to the immigration of people with essential skills;
- the telecommunications sector, where CRTC policy appears to discourage corporate R&D expenditures; and
- corporate liability laws, to ensure that they do not unnecessarily discourage risk-taking.

The new Department of Industry, Science and Technology should act as a catalyst and facilitator to help bring together Canadian skills and resources on a national basis to produce the critical mass required for Canadians to be competitive on an international basis.

The new department should not attempt to initiate policies and programs addressed to every industrial sector. Rather, it should become more responsive to needs which industry identifies. The department should not create new programs in search of clients.

With respect to bailouts, when these are seen as necessary, the government should insist that corporate shareholders participate in the cost of that restructuring — which may well include changes in management personnel where indicated.

The government should assist in identifying and providing data on export opportunities and should improve business access to this information.

The government should also assist in coordinating trade missions to other countries and ensure that these missions include our best representatives.

The responsibility for foreign trade should be transferred from External Affairs to the new Department of Industry, Science and Technology. (That was a request that came forward from the members, not the bureaucrats.)

Government procurement practices should promote higher value-added Canadian products through such means as:

- Canadian preferences, including, in some cases, developing new products rather than buying off the shelf;
- insistence on offsets and transfers of technology where offshore procurement is involved;
- procuring entire systems rather than individual components; and
- assisting small and medium-size businesses with longer time periods for the preparation of contract bids and the review of more realistic overhead allocations.

Government should not neglect opportunities to apply technology to some of its own activities. The enormous expenditure on translation into our

two national languages may have some potential in this regard.

Government should not attempt to develop skills which private industry can supply (Hydro Quebec's use of SNC and Lavalin engineers is a positive example.)

BUILDING ON STRENGTHS

The longer-term approach to adding value to Canadian products for international competitiveness should be oriented to building on Canada's traditional strengths and needs. Examples are natural resource harvesting, extraction and processing (fishery, forests, agriculture, minerals, hydrocarbons); aerospace; transportation and communications; remote sensing and mapping; hydroelectric generation and transmission; operating in hostile northern or offshore environments; and protecting air and water quality.

Governments should focus on promoting research and development on such longer-term priorities. Research in universities should also be oriented to such basic knowledge.

More businesses should consider devoting a percentage of corporate R&D budgets to supporting such long-term research activities. They must recognize their economic interest in ensuring that universities conduct this basic research, upon which future technological progress will be based.

Business should no longer see itself as a patron but as a partner of institutions of higher learning

CENTRES OF EXCELLENCE

We support your concept, Prime Minister, of centres of excellence. However, we do have some concerns about how it will be implemented, as did John Evans in his speech this morning.

The selection of centres must truly be based on excellence in areas of national strength. Regionalism must not be allowed to undermine this important initiative. Each centre should have a national mandate which includes drawing on scientists and researchers from across the country and diffusing technology through cooperative networks across Canada.

Strong participation of the business sector, through boards of directors with inputs to the decision-making process, is essential.

The centres' activities should be a mix of basic and applied research. Research centres other than those based at universities should also be eligible for consideration under the program.

In closing, Prime Minister, we recognize that you have provided leadership. You have demonstrated your own personal commitment to meeting this great national challenge.

It is now up to the leaders of the business, university, labour and government communities to take up your challenge.

We need to forge a partnership to take the steps required, on the threshold of the 21st century, for Canadians to realize their economic potential on the global scene.

BUILDING NEW TECHNOLOGY-INTENSIVE FIRMS

WORKSHOP SESSION C SUMMARY REPORT

WORKSHOP DIRECTOR: RITA DIONNE-MARSOLAIS

JANUARY 15, 1988

THE CLIMATE

A favourable climate must exist in order for entrepreneurs to make their appearance and flourish. Entrepreneurship is not the aggregate of a person's technical knowledge. While the insight and reflexes of an entrepreneur are innate, certain environmental factors conducive to the realization of his or her potential can be identified. The environment needed to facilitate the creation of technology-intensive firms has certain specific requirements.

Education

The availability of highly qualified personnel is an essential factor in the development of companies whose sustenance is technology and innovation. In Canada, the challenge is all the greater, given provincial jurisdiction in the matter. The provinces must therefore show their commitment to this challenging undertaking.

Recognition of Entrepreneurship

The presence of companies which recognize the importance of innovation greatly influences future entrepreneurs and ensures that opportunities for commercial success follow naturally.

Encouragement and Public Support for Innovation

The presence of a nucleus of individuals who have already embarked on the development course often provides not only a model but also a valuable source of information, resources, encouragement or reference for the future. Public recognition of the efforts involved in innovation heightens the impact of these efforts in society.

The climate conducive to innovation, which we are trying to achieve, has to emerge first in the regions. Canada's geography is such that the process begun today must be extended. It is hoped that these discussions will be continued at the regional or provincial level and that efforts to create a climate conducive to innovation will first have concrete results at that level, which will then merge to become a Canadian reality.

THE MEANS

Established Firms

In-house entrepreneurship can be fostered by management practices, attitudes and language which indicate high receptivity to new ideas, new projects and the use of initiative.

Company heads should encourage start-ups arising out of the ideas of their employees by putting up seed money for such in-house initiatives; by offering reassuring support in the form of a large first order; or by cooperating in a joint venture to develop a specific application. In some cases, incubation in a parent company or a different infrastructure (universities) has had positive results.

Established firms can also show their support by purchasing from, sponsoring or investing in other companies which fill a specific supply requirement. This is particularly appropriate for subsidiaries of multinational corporations, especially those with international mandates.

As individuals, company heads can play a big-brother or big-sister role and provide advice to beginners by sitting on the company's board, by making direct investments (individual or corporate) in the company or even by raising the necessary capital.

Financial Institutions

In theory, Canadians are among the world's biggest savers, after the Japanese. The problem lies in the availability of this capital for technological and business development and a poor knowledge of management of technology-intensive companies.

Communication between entrepreneurs and the

capital pools is erratic. Entrepreneurs complain that venture capitalists do not understand real market conditions, while financiers criticize entrepreneurs for their lack of management skills.

One solution that should be considered is along the lines of Quebec's stock savings plan, which provides for the financing of risk-oriented projects through an off-line savings program that benefits all parties. A company developed with equity financing will have a sounder financial structure and will be able to compete on the North American and international markets more rapidly and more successfully.

Universities

It is important for students to take part in practical training sessions in companies so as to gain a more realistic view of the business world.

The participation of university professors in various stages of corporate development adds a different and stimulating dimension to innovation at the company level.

Cooperation between industry and universities accelerates both the development process and the introduction of new technological know-how.

The Government's Role

There are a multitude of government programs aimed at stimulating the creation of new companies. These programs were felt to be sufficient in number, but participants found there was room for considerable improvement, such as greater administrative flexibility and a more rapid response on the part of those in charge. Certain programs lack coherence, and their effects will often cancel each other out. One glaring example is the recent tax reform, which was viewed by participants as contradictory in terms of support offered for efforts in the areas of innovation and technology. Revenue Canada and the new Department of Industry, Science and Technology will have to agree on the nature of R&D so that companies can continue their activities in innovation without fiscal harassment. Furthermore, all participants recalled with nostalgia the days of tax credits for scientific research, which had incomparable benefits for certain small businesses.

Another important lever which the government can use to assist in the development of fledgling firms is undoubtedly its purchasing power. Unfortunately, the successes attributable to effective use of this lever are rare, and we are relying on the new department to take the necessary decisive action to ensure that this lever is put to good use.

The proposed centres of excellence will have to be developed with caution. Cooperation with business is essential. There is doubt, however, as to whether the centres should be located on university campuses. Industry representatives have offered to help the government establish its priorities in this regard.

Lastly, intellectual property is important for any country planning coordinated economic development, and Canada is no exception. In particular, if the government undertakes research in cooperation with industry, it is essential that industry researchers be assured of property rights.

Bruce Howe, Chief Science Advisor to Government

A NEW CULTURE

The climate created by these measures and the means provided for their implementation will give rise to a new culture which will favour initiative, a new culture which is already evident in certain regions (such as Quebec) and which will alter the deep-rooted culture of the population. It will be characterized by:

1) pride in the capacity for innovation and adaptation;

2) the recognition of success and of the entrepreneur;

3) a taste for risk, growth and expansion;

4) enthusiasm on the part of the general public and the media for success, ambition and innovation; and

5) a national identity through the pursuit of

excellence, regardless of regional disparities and the constraints they engender.

This is the sincere hope of the participants at the close of this workshop.

In closing, we suggest that Canada should follow the example of Alcan and issue a mission statement concerning innovation and technology, now that a new department has been created to integrate industry, science and technology.

Workshop members would gladly and without reservation support you in such an endeavour. Canada has grown, and Canadians are ready to take up the challenge of economic development through innovation and the application of technology.

We thank you for this opportunity to express our vision of Canada in the year 2000.

CLOSING REMARKS

BY

THE RIGHT HONOURABLE BRIAN MULRONEY

PRIME MINISTER OF CANADA

JANUARY 15, 1988

[English]

I want to thank you all for giving these three days. They were really three days to the service of Canada, to the cause of ideas and to the future of our children. The people in this room, each and every one of you, are leaders of our country in a dozen different ways ... I suppose with a special emphasis on the scientific dimension of our national life. You have provided a real impetus and a real stimulus to the development of this country's science and technology agenda for a new decade and a new century.

But the progress of consultation didn't begin here, nor does it end here. We began with the Winnipeg Forum in June of '86, where a consensus developed among representatives of industry, labour and the universities that science and technology, which had not been a national priority, ought to become one very quickly. I've held that view for some time.

In October of '86, we announced our intention to create the National Advisory Board on Science and Technology (NABST). We brought together 40 eminent Canadians from across the country with myself as chairman of the National Advisory Board on Science and Technology, which will come as a surprise to my physics teachers. I met as chairman with this group, I suppose four or five times last year, for meetings that were without much if any publicity, in reflective settings, meetings lasting two, three and four hours. Most of the Ottawa media were completely unaware of the work that was going on in terms of the

planning for this kind of a meeting and the very substantial changes we have to bring to our national life.

This is not something we dreamed up yesterday. Perhaps I could give you the best indication. If you're here, it's because you have a lot to do. No indolent people were invited to this conference, no people without qualifications. By and large, if you are here, you have played a very successful role in your communities and elsewhere in the country. I have a busy life myself; I don't look around for things to do. I try to get rid of a lot of responsibility in terms of asking others to assume it.

I have reduced my own workload in terms of executive chairmanship of government. Apart from chairing Cabinet and chairing the Priorities and Planning Committee of Cabinet, the only other one that I chair is the National Security and Intelligence Committee of the government, with one exception. I took on the chairmanship of the National Advisory Board on Science and Technology, because I believe it's that important in the government. It's important to the national life of Canada that it be chaired by the Prime Minister.

I give you the assurance that you have not spent three days in Toronto in vain, that I share your enthusiasm. I wish I could afford more of it. We can afford some of it and, as a country, I suppose we'll have to find ways of affording more of it, because I share your enthusiasm for the proposals being put forward. I suppose most of all, as busy human beings, we persuade one another of that by the human commitment we're prepared to make to this.

You've come up with some very solid and sensible recommendations. The National Forum on Post-Secondary Education in Saskatoon was very helpful for other reasons, complementary reasons. The Toronto conference has been an invaluable exercise for all of us. I asked you for frank talk and exciting ideas, and I heard a lot of both — in the first plenary session, in the workshops I attended yesterday, in the reports that I've been getting from Bruce Howe throughout the Conference and of course in your recommendations this morning.

As part of the follow-up to this conference, the government will sponsor a series of five regional conferences across the country — in British Columbia, the Prairies, Ontario, Quebec and Atlantic Canada.

[Translation]

The follow-up regional conferences will give Canadians who could not attend this conference an opportunity to present other ideas, perhaps new ones. They will also give our regions an opportunity to have more direct input.

We have heard many interesting presentations and comments over the last three days, and I know you will want me to thank particularly Pierre Lortie, David Culver, Ed Fitzgerald and John Evans for their most enlightening speeches that helped focus the discussions.

"I think there have to be some attitudinal changes in the country..."

[English]

In the 30 workshop sessions, you've discussed three basic themes that are central to developing our science and technology capacity — revitalizing established industries, developing higher-value products and building new technology-intensive firms. Overall, two or three themes seem to have emerged there.

One theme is the importance of fostering and consolidating a culture of science and technology in Canada, a climate within which excellence in science and technology is no longer taken for granted but celebrated for the magnificence of its contribution to our national life. And that involves all of us in developing that culture.

[Translation]

We want to provide role models in science and technology for our youth, especially for our young women, as they enter the work force. At present, only one in ten engineering and science students is a woman. We have to do much more; we have to train women like Rita Dionne-Marsolais and Roberta Bondar. We want them to reach for the top.

But how will this new culture come about? We have to make the public more aware of the importance of science and technology in the life of our country and of the need for progress in this area to ensure our future international competitiveness.

[English]

You've given us refinements and variations of some advice that I have heard at NABST meetings and from the National Council of Science and Technology Ministers at their meetings. Last night, Frank Oberle announced a federal initiative for a $10 million national cooperative effort to increase public awareness, and I invite the active participation of all sections of our industrial sector.

There's a word here that's not inappropriate ... participation. I remember, and I'm sure many of you do, the Participaction program. It was brought in by another government, so I can mention it without being accused of patronage. Who would want to do that anyway? But it was a successful program. It was a tremendous program. The Participaction program achieved in the public's mind. It left a message that we want to leave in respect to science and technology, and that relates directly to culture. We want the young people of this country walking around with that squarely imprinted on their minds, and that comes about in large measure because of the kinds of programs that the $10 million will produce.

We also need to support excellence in our teachers, those who first challenge our young minds and then prepare those minds willing to learn. We must be prepared to teach not only the young, but also any Canadian who wants to learn more and new things. Not only should we teach them science and technology, but also we should teach them to use it better.

The second theme that has clearly emerged is the activities and initiative that the private sector must undertake. We warmly encourage you to do so. People talk about a comment that I made about doubling the commitment to research and development. That's doubling the national commitment, not just government involvement. It is creating a climate wherein all sectors move up with their commitments. It is not just the federal government writing a cheque for borrowed money; it is creating the climate within which the private sector, especially, responds to a great national challenge.

Part of the culture in Canada is that if it doesn't come from a cheque from the federal government, it doesn't exist. Nothing could be further from the truth. All Ottawa has been doing is spending your borrowed money and putting a mortgage on the backs of your kids and their kids. Real investment comes from the investment of real dollars in real projects, not borrowed money, and that involves creating a climate, not a facile thought that the government simply enhancing its spending is going to solve the problem. That would create the problem.

What we must do is harness the genius — not only scientific, but also entrepreneurial genius that's in this room and in rooms like this across the country — and together create a climate which will reward that sense of brilliance and creativity ... not only reward it, but celebrate it for the splendid contribution that it brings to our national life. And that does not simply involve the process of a Minister of Finance or a Minister of Science writing a cheque ... although that's helpful Frank. I don't want to discourage any of them if they're thinking that way.

I think there have to be some attitudinal changes in the country, as well, in respect of how we achieve this, and not just in the Canadian marketplace, but where we do business as well. You have said that you in industry, like many of us, are lacking in scientific and technological capability. I think that recognition alone is one of the first steps in overcoming this deficiency.

Another theme that has emerged here — perhaps a little pedestrian, but it's not unattractive,

because it is true — is that we are all in this together. We are, in this sense, truly Team Canada. If Canada is looking for leadership in science and technology, this is it. You are the best in the country, from all walks of life, and Canada is counting on you, not only for the ideas and leadership, but also for the follow-through. The integration and interchange between universities and industry is vital to our industrial future.

[Translation]

Obviously, the government also has a role to play in those areas, for example, in public affairs, as Rita Dionne-Marsolais and David Hennigar have mentioned. Today, I have asked Ministers de Cotret and Côté to meet with Jean-Paul Gourdeau to develop an adequate approach for that area of public policy. The workshop directors have informed me of many of your tremendous recommendations. I will review them to see if they are feasible, which is probably the case for many of them. For example, you have recommended precise measures the government could take to speed up progress in science and technology. I recognize that, in certain areas, we need better coordination and that, in other areas, we should withdraw. I am keenly aware of that.

[English]

I suppose that's where the new Department of Industry, Science and Technology comes in. This department is about industry, but it's also about your brilliance. And it will be different from its predecessors in that it will be decision-oriented. You've made recommendations on the Centres of Excellence, the Canada Scholarships, the teaching profession, increasing public awareness, increasing university-industry interchanges, taxation and other ideas we're going to be getting a good look at.

The Centres of Excellence and the Canada Scholarships in science and engineering represent part of our commitment to excellence — academic excellence, competitive excellence, world excellence. Consider the Canada Scholarships. We're going to have an estimated 2,500 students a year, 10,000 students when the program comes fully on stream. They'll be known as the Canada Scholars, and they are going to establish standards against which future generations will be measured. And so, for this generation, we hope gifted secondary students can aspire to be Canada Scholars.

[Translation]

I hope this won't embarrass you, but this initiative holds a special place in my heart. This conference is more than consultation, and it is more than change. I view your participation very much as an important element in the decision-making process. We have taken consultation far enough, and I think that your participation is an important instrument of change, but in the decision-making process. So, I want to thank you.

[English]

I suppose it's appropriate that I leave this conference and jump in the car to go out to the airport to welcome the Prime Minister of Japan, who will be here at noon, because of their incredible record over the last 40 years. They have not only moved mountains, but also they have moved into new generations of thought and brilliance and accomplishment by using what Walter Light referred to, that inexhaustible reservoir of brain power called technology. We have just as much brain power. It is a question of harnessing it and using it a little better, transmitting it and diffusing it better, and putting it into the kind of collective harness we've seen today.

I think you've done a tremendous job. I think this conference has been a very important milestone in the scientific and technological evolution of Canada, and I want to say congratulations to all of you. I want to say thank you, and I'll be telling the Prime Minister of Japan: "Hang onto your hat. Hang onto your hat, Canada is coming on the scientific field."

EXHIBITORS

The Core Exhibit on Canadian Science, Technology and Innovation successes Space and Engineering achievements was developed with the participation of:

- Canadian Government Expositions Centre
- Conseil de développement du loisir scientifique
- Secretary of State
- Women's Inventors Project
- Youth Science Foundation

The Thematic Exhibits were developed by:

Government

Agriculture Canada
Canadian Forestry Service
Consumer & Corporate Affairs Canada (Patent Office)
Department of Regional Industrial Expansion
Energy, Mines and Resources Canada
Environment Canada
Fisheries & Oceans
International Development Research Centre
Medical Research Council of Canada
Ministry of State for Science and Technology
Municipality of Metropolitan Toronto
National Defence Canada
Natural Sciences & Engineering Research Council
Science Council of Canada
Social Sciences & Humanities Research Council
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Private Sector

Alcan Aluminium Ltd.
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Forintek Canada Corp.
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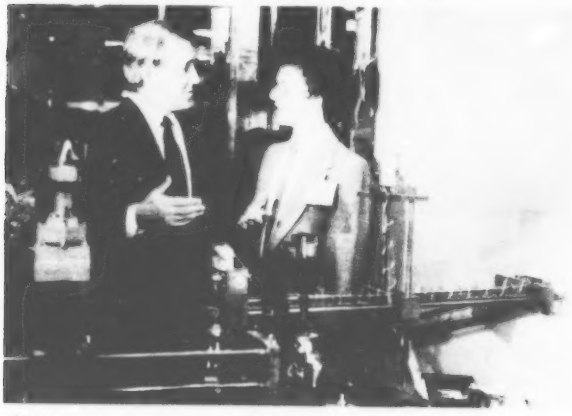
NewTech Instruments Ltd.
NORR Partnership Ltd.
Pratt & Whitney Canada
William G. Hutchison & Co. Ltd.

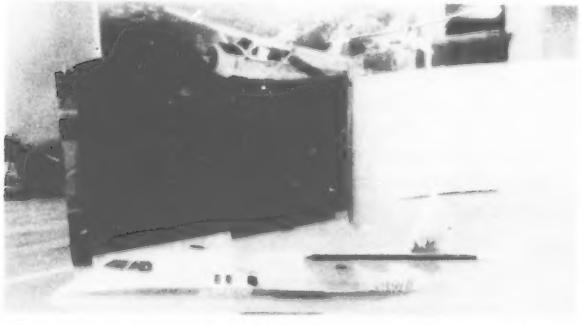
EXHIBIT

A Celebration of Excellence

In keeping with one of the three themes of the National Conference on Technology and Innovation, the exhibit was a celebration — of Canadian achievements, inventions, innovations and the people behind them. The celebration was launched with a ceremony involving the Prime Minister, several federal ministers, and Canadian astronauts Marc Garneau and Roberta Bondar.



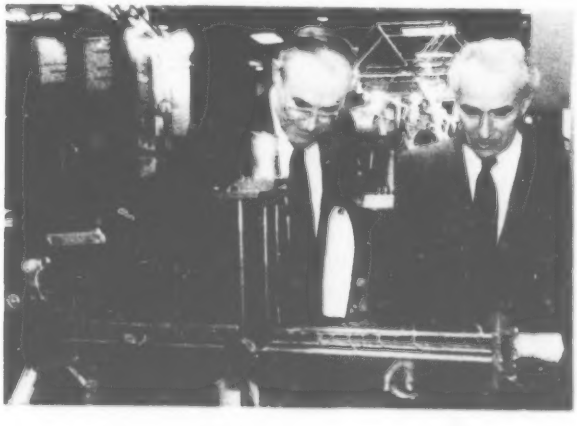
Government and private-sector exhibitors told a variety of Canadian success stories through the use of artifacts, models, photos, text and audio-visual displays. Exhibitors' topics ranged from corporate megaprojects to back-yard inventions, from technical wizardry to marketing expertise.



One of the exhibit's highlights marked the 100th anniversary of professional engineering in Canada with displays devoted to Canada's ten greatest engineering feats over that period. Megaprojects

figured prominently in this part of the exhibit — from the national dream, the railway network uniting this vast and rugged country; to the canals and locks that create the 3700 km of waterways of the St. Lawrence Seaway; to the James Bay hydroelectric project; to the development of the Alberta oil sands.

In contrast to these huge undertakings, a project that began in Joseph-Armand Bombardier's back yard was also portrayed in the top ten engineering feats. In the early 1920s, Bombardier transformed Model T Fords into crude snow machines that do not much resemble the sleek snowmobiles put out today by the company that bears his name.



Rounding out the displays on our greatest engineering achievements were stories concerning aeronautics, atomic energy, manufacturing, telecommunications and aerospace. The de Havilland Beaver aircraft, nicknamed Canada's flying jeep, was known for its rugged construction, its spectacular short take-off and landing performance, and its versatility. Canada was one of the first countries to enter the nuclear age, harnessing atomic energy for nuclear-generated electricity, radiotherapy equipment and other applications. Polysar, the world's largest producer of synthetic rubber and latex, started out as a Crown corporation, producing material for the Allies in World War II. Since then, it has progressed steadily and now produces material for state-of-the-art radial tires and other products to meet the exacting demands of the aerospace industry. Canada is also the home of the longest single microwave route in the world, an electronic highway travelled by nearly all of our long-distance communications. Finally, the display recounts the story of the Alouette 1, which made Canada the third nation in the world with an orbiting satellite. This firmly established our reputation for excellence in satellite technology and space science.

Another section of the exhibit focused on Canadian achievers, including Nobel Prize-winning chemist Dr. John Polanyi, neurosurgeon Dr. Wilder Penfield, cardiologist Dr. Wilbert Keon, and another Nobel Prize-winning chemist, Dr. Gerhard Herzberg. Women have also made significant contributions in the field of innovation, and several of them were profiled in this part of the exhibit. Tribute was also paid to award-winning science students, the household names of the future.

Little-known Canadian innovations were also featured in the exhibit. Highlights ranged from the invention of Pablum by doctors alarmed by infant disease and malnutrition; to the Jolly Jumper, inspired by an Indian cradle board hung from tree branches; to the Sackbut, an early musical synthesizer; to the Robertson screwdriver, the snowblower, and the paint roller. While most of the innovations relate directly to technology, the marketing of technology was the story in some displays. For example, though a Canadian did not invent the zipper, a Canadian first made it a commercial success.

The Hon. Flora MacDonald and the Prime Minister hold up a model of SHARP, Canada's high-altitude microwave plane during the opening of the exhibit as astronaut Roberta Bondar (centre) looks on.

The exhibit also demonstrated the contribution of various participants in the cycle of innovation and the steps involved in developing a new product, underlining the crucial importance of science policy development and linkages between the various sectors of the economy. It also drew attention to the significant contribution of technology to sectors such as agriculture, fisheries, energy and mining.

During the three days of the conference, the exhibit was viewed by more than 2000 people, many of them students. Undoubtedly, it achieved its goal of raising public awareness of Canadian accomplishments and potential in technology and innovation.

STEERING COMMITTEE

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Private Consultant

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M. Jean-Marc Carpentier
Journalist

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Ministry of State for Science and Technology

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President
William G. Hutchison and Co. Ltd.

Mrs. Lana de Liamchin
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John Abbott College

Dr. Geraldine Kenney-Wallace
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Vice-President, Information
Canadian Nuclear Association

David Hennigar
Director
Burns Fry Limited

Dr. Norman Keevil
Chairman
Teck Corporation

Assistants

The Workshop Directors of the National Conference on Technology and Innovation reported to the Prime Minister at the end of the conference on the results of the workshop deliberations. Three senior federal officials and their assistants helped the Workshop Directors in the drafting of these reports.

Robert Blackburn
Assistant Deputy Minister
Policy and Evaluation
Department of Regional Industrial Expansion

Roberto Gualtieri
Deputy Secretary
Government and Universities Sector
Ministry of State for Science and Technology

Jean-Jacques Rousseau
Assistant Secretary for the National Advisory Board on Science and Technology
Ministry of State for Science and Technology

They were assisted by Lynn E. Burton, Senior Advisor, Secretariat of the National Advisory Board on Science and Technology; George Skinner, Economist, Department of Finance; and Lyse Morisset, Senior Advisor, Secretariat of the National Advisory Board on Science and Technology. Secretarial support for the preparation of the reports was provided by Sandy Battison, Deborah Burgoyne and Gisèle Larivière.

WORKSHOP DISCUSSION LEADERS

Stephen Acres
Director
Veterinary Infectious Disease Organization

William Cochrane
Chairman of the Board and Chief Executive Officer
Connaught Laboratories Limited

R.O. Fournier
Assistant Vice-President (Research)
Dalhousie University

Patricia Baird
Professor
Medical Genetics
University of British Columbia

Alexander Curran
President
Telecommunications Research Institute of Ontario

Jean-Paul Gourdeau
Chairman & Chief Executive Officer
The SNC Group

Pierre Bélanger
Dean
Engineering
McGill University

Jeannine David-McNeil
Professor
Economics
Ecole des hautes études commerciales

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